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15 July 1981

Japan Report

(FOUO 41/81)



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JAPAN REPORT

(FOUO 41/81)

CONTENTS

SCIENCE AND TECHNOLOGY

Complicated Plate Ends Said To Cause Complicated Earthquakes (TECHNOCRAT, Apr 81).....	1
Ocean Development Creates Demands for Machinery Industry (Riko Nagasaki; BUSINESS JAPAN, Jun 81).....	7
First Enrichment Plant Using Chemical Exchange Process (TECHNOCRAT, Apr 81).....	11
PNC's Uranium Ore Prospecting (TECHNOCRAT, Apr 81).....	12
SCC Study Under Reactor Environments (TECHNOCRAT, Apr 81).....	14
Submerged Cutting of Steel Plates for Nuclear Reactor Pressure Vessels (TECHNOCRAT, Apr 81).....	15
Testing, Inspection Using Electric, Electrical Equipment (Shigeo Sakai, Kazumasa Nakamura; TECHNOCRAT, Apr 81).....	16
Computer Makers Compete Over Market for Office Automation Equipment (Yukio Shimura; CHUO KORON, No 3, 1981).....	25
On-Line Measurement Inspection Centered on Automatic Sorting System (Masahiko Fukazawa; TECHNOCRAT, Apr 81).....	35
Automatic Inspection Using Microcomputers (Oharu Suda; TECHNOCRAT, Apr 81).....	43

- a -

[III - ASIA - 111 FOUO]

FOR OFFICIAL USE ONLY

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Large-Scale Individual Credit Information System Begins Operations (TECHNOCRAT, Apr 81).....	50
LISP Processing Exclusive Computer Experimental Model Manufactured (TECHNOCRAT, Apr 81).....	51
All-Time Record for Plastics Machine Industry (Katashi Aoki; BUSINESS JAPAN, Jun 81).....	53
Brisk Demand Continues for Plastic Processing Machines (Atsushi Iida; BUSINESS JAPAN, Jun 81).....	55
Biomass as an Energy Source (TECHNOCRAT, Apr 81).....	60
Reorganization of Caustic Soda Industry Suggested (Masaji Yamamoto; BUSINESS JAPAN, Jun 81).....	80
Manual on Factory Noise Assessment Compiled (TECHNOCRAT, Apr 81).....	86
Highly Efficient Automatic Screw Gauge Meter (TECHNOCRAT, Apr 81).....	90
Measuring Instruments Related to Light Laser (TECHNOCRAT, Apr 81).....	91
20 kW Laser Machining System Adopted (TECHNOCRAT, Apr 81).....	92
Automatic Measuring Control System for Large Machine Tools (TECHNOCRAT, Apr 81).....	93
NC Robot for Applying Sealing Agents (TECHNOCRAT, Apr 81).....	94
Recording Traveling Locus of Automobiles (TECHNOCRAT, Apr 81).....	95
One of Nation's Largest Industrial Aerodynamics Wind Tunnels Completed (TECHNOCRAT, Apr 81).....	96
Belts for Cars Reduce Car Body Weight by 15kg (TECHNOCRAT, Apr 81).....	97
High-Speed Encapsulation Device Developed (TECHNOCRAT, Apr 81).....	98

- b -

FOR OFFICIAL USE ONLY

FOR OFFICIAL USE ONLY

Large Aperture Gap Single Crystal Development Completed (TECHNOCRAT, Apr 81).....	99
Capital Spending in Electrical Industry Reported (TECHNOCRAT, Apr 81).....	100
Elongated Image Fiber Permits Direct Image Transmission (TECHNOCRAT, Apr 81).....	101
High-Speed LSI Light Data Link Developed (TECHNOCRAT, Apr 81).....	102
Development of Academic Information System Earnestly Pursued (TECHNOCRAT, Apr 81).....	103
Development of Biocell Discrimination, Separation Equipment (TECHNOCRAT, Apr 81).....	104
Automatic Analyzing System for Laboratories (TECHNOCRAT, Apr 81).....	105
Development of Methanol Chemistry (TECHNOCRAT, Apr 81).....	106
Corrosion Test of Super Hard Ceramic With Thermal Resistance (TECHNOCRAT, Apr 81).....	107
Control System of Power Process by Computer (TECHNOCRAT, Apr 81).....	108
Industrial Production of Carbon Fiber To Commence Soon (TECHNOCRAT, Apr 81).....	109
Electric Conductive Fiber Begins Commercial Production (TECHNOCRAT, Apr 81).....	110
Model System for Recycling Industrial Waste Under Development (TECHNOCRAT, Apr 81).....	111
Experiments With Dissolved Air Flotation in Activated Sludge (TECHNOCRAT, Apr 81).....	112
Government Building Up Marine Development (TECHNOCRAT, Apr 81).....	113
Joint Study for Current Power Generation Utilizing Nation's Current (TECHNOCRAT, Apr 81).....	114
Successful Test of Air-Lift Collector of Manganese Nodules (TECHNOCRAT, Apr 81).....	115

- c -

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Seawater Desalination Pilot Plant Based on Refrigeration Using LNG's Low Heat (TECHNOCRAT, Apr 81).....	116
New MAFF Research Themes Detailed (TECHNOCRAT, Apr 81).....	117
Development of New Method To Prevent Fall-Off of Incorporated Genes (TECHNOCRAT, Apr 81).....	119
Experimental Multipurpose HTGR Practically on Target for 1988 Criticality (TECHNOCRAT, Apr 81).....	121
Joint Efforts With U.S. in RTNS Project (TECHNOCRAT, Apr 81).....	122
Superhigh Head Pump-Up Power Generation (TECHNOCRAT, Apr 81).....	123
Synthesis of Thermally Stable Oils by Benzylation of Biphenyl With Benzyl Chloride Catalyzed by Iron (III) Oxide (TECHNOCRAT, Apr 81).....	125
Briefs	
50-Day LPG Stockpile	128
Cementing Coal Ash	128
Crude Solidification Stockpile	128
Practical Wind Power Heating	129
Silicon Solar Battery Efficiency	129
Marine Nuclear Power Plants Survey	129
System Decontamination of Radioactivity	130
Operatorless Plant With Self-Control	130
Enamel Coating Robot	130
Range of Industrial Robots	131
Portable Seawater Desalination System	131
1M-Bit Magnetic Bubble Memory	131
Ion Beam Equipment	132
Microcomputer Controlled Welding Machine	132
Main Shaft-Driven Generator	132
Optical Fiber Laser Gyrocompass	133
Thermal Printer Head for Thin Film	133
Asynchronous 128K Bit Mask ROM	133
Character Panel Display	134
On-Line OCR, Facsimile Systemization	134
Automatic Check Equipment	134
Glass-Fiber Reinforced Plastic Composite Pipe	135
Semisubmerged Rig	135

- d -

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SCIENCE AND TECHNOLOGY

COMPLICATED PLATE ENDS SAID TO CAUSE COMPLICATED EARTHQUAKES

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 53-55

[Text]

The prediction of natural phenomena depends for its accuracy on the certainty of the following two criteria: 1) that the mechanisms of natural phenomena are fully understood, and 2) that their present status is clearly known. For example, one natural phenomena which can at present be predicted very accurately is the movement of heavenly bodies. We can without fail predict a solar eclipse with an accuracy to the second of its start and end. We can foresee the exact time of daily sunrises, sunsets, and tidal rises and falls. We can predict these with exactitude because we are quite familiar with the mechanisms of the movement of heavenly bodies and we know the exact present locations of them from observations over a long period of years. This fulfils the two requirements mentioned above.

However, some natural phenomena are hard to predict and earthquakes are among them. There are two reasons for this: the mechanisms that govern the occurrence of earthquakes are not known adequately enough in detail and the crusts of the earth are also not known with sufficient accuracy. Nevertheless, many of the severe earthquakes of about magnitude 8 have recently been understood to make them relatively predictable.

In Japan, earthquakes of magnitude 8 occur only off the coasts of the Pacific Ocean. This is because the Pacific Ocean Plate is sinking under the Asian Plate on which the Japanese Islands are situated, causing the edge of the Asian Plate to subside. (Fig.1). When this subsidence exceeds a certain limit, crusts are destroyed, resulting in severe earthquakes.

It is believed that, in earthquakes off Tokyo, crustal destruction is caused when the subsidence exceeds about 90cm. And it is further believed that, since the subsidence at present has progressed by about 30cm, there will be no severe earthquakes for some years in the Kanto District (areas in and around Tokyo). Areas in which severe earthquakes are feared in the near future are in the Tokai District about 150-200km southwest of Tokyo. Observations indicate that the accumulation of energy sufficient for crustal changes has exceeded the crisis level. It will not be a source of surprise therefore if an earthquake occurs there tomorrow. Thus, a reliable observation system and a powerful precaution system have been established in the Tokai District.

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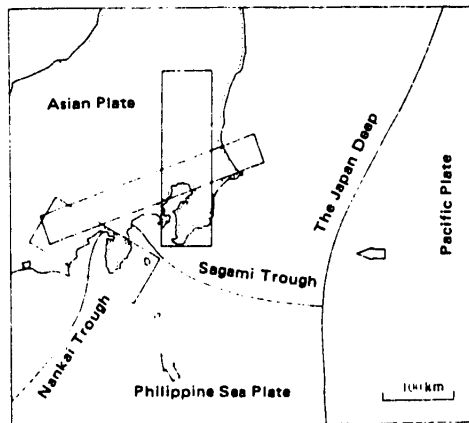


Fig. 1. Three Plates Meeting One Another in Kanto and Tokai Districts

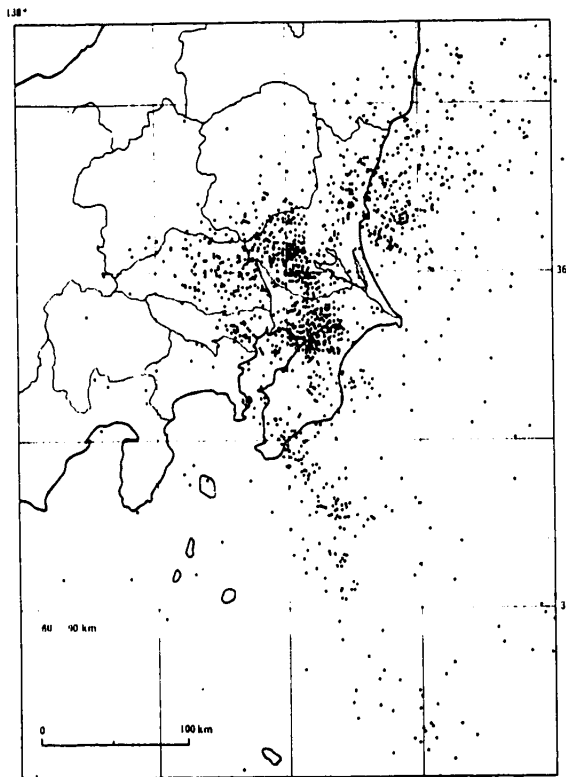


Fig. 2. Distribution of Seismic Centers (for Earthquake
(for Earthquakes with Depths of 60–90km)
(for Kasahara)

2
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In addition, effective laws which provide for the prediction of earthquakes, the prevention of disasters resulting from them and measures to be taken when they are detected, have been established and are being urgently implemented.

Apart from the severe variety, earthquakes of below magnitude 7 have frequently rocked Japan. Compared with the knowledge of earthquakes of magnitude 8, the mechanisms of the occurrence of these milder ones, together with the present conditions of their respective crusts, are little known. In and around Tokyo at present, earthquakes which are feared to cause major disasters are of this type. Seismologists are making the utmost efforts to understand the mechanisms of their occurrence and the present conditions of the crusts relating to them. The observation of smaller earthquakes at 3 deep wells, about 2000m deep, in the suburbs of Tokyo, which has often been reported in TECHNOCRAT, represents one of their efforts. Cumulatively, these efforts are gradually producing favorable results, giving a bright prospect for the eventual prediction of these type of earthquakes. A model of the crust of the earth in the Kanto District, which has been proposed by Kasahara and which is described below, is attracting attention as a framework for explaining the mechanisms of the occurrence of these local earthquakes.

The region including the Kanto and Tokai Districts is one of the most seismic areas in Japan because it is at the intersection point of the three plates, i.e. Asia, Pacific and Philippine. The conditions of the plates at this meeting point have so far not been fully understood.

Supported by recent highly accurate results for the determination of seismic centers and seismic mechanisms, Keiji Kasahara, a researcher at the National Research Center for Disaster Prevention, has proposed an innovative model which systematically describes the conditions of the northern edge of the northern edge of the Philippine Plate. The model explains the three-dimensional distribution and the seismic mechanisms of the earthquakes in the Kanto and Tokai Districts, and, furthermore, shows that it can form the basis for discussing all geographical phenomena in the district. Needless to say, this research is meeting with an enthusiastic public response.

Up till now, it was believed that the edges of plates have rather simple shapes. Fig.1 shows a conceptual sketch of the plate junction as it is conventionally conceived. The Pacific Plate which moves westward at a speed of several centimeters per year sinks under the Japan Islands along the Japan Deep. The northern edge of Philippine Sea Plate, which moves north-westward, is bordered on the east by the Sagami Trough and on the west by the Nankai Trough, meeting with the Asian plate. If the junction is considered in a simple way like this, a lot of phenomena are found to be beyond explanation. Fig.2 shows the distribution of seismic centers in the Kanto District.

The following questions have been presented without being logically answered:

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- Why does a very seismic band run northeastward through the center ?
- Why do earthquakes in the very seismic central zone cause extraordinarily large magnitudes to be recorded in the Izu district more than 100km away ?
- Why in 1973/4 was there a sudden and consistent change in the pattern data of crustal changes for the Chubu District ?
- Why do earthquakes with relatively shallow seismic centers occur as for example, the Great Earthquake of 1923 in the Kanto district? These are also expected to occur in the future, bringing about major disasters.

The Kasahara model gives some very systematic and meaningful answers to these questions. Fig.3 shows the concept of the model proposed by Kasahara.

The outline of the Kasahara model is as follows:

The Philippine Sea Plate generally moves northwestward in relation to the Asian Plate and is divided into 3 portions: the eastern wing (I), the central body (II) and the western wing (III) in the vicinity of the Izu peninsula. The border between I and II consists of sliding leftward (SL) faults running approximately from south to north, which are represented by the Tanna fault and the border between II and III. Sliding rightward (SR) faults, running approximately from west-northwest to east-southeast, are represented by the Irozaki fault. Each one of them is not clearly divided by a single fault but is separated by a broad transitional zone. In this sense, areas in which SL and SR have developed (nearly the entire area of the Izu peninsula) are here called the "Izu Shear Zone".

The eastern wing (I) of the Philippine Sea Plate is driven by SL under the Kanto district, its northern edge (A-B in Fig.3), reaching the line between the north of the Saitama Prefecture and the center of the Ibaragi Prefecture. Its eastern edge (C-D in Fig.3) is guided, in contact, by the Pacific Plate which sinks easterly. The plane on which both plates are in contact with each other is located at a depth of around 60-90km. The central body (II) runs against the Asian Plate in the east of Yamanashi Prefecture, while the western wing (III) is driven by SR to the west of Suruga Bay.

The Philippine Sea Plate as described here is far from a simple oceanic plate imagined to be neatly sinking under the land. Torn lengthwise and crosswise, it meets generally in a hangnail fashion with the Asian Plate.

It is recognized that this model not only agrees quite well with observations which will be described later but also has not been confronted with any contradictory findings.

FM1 through FM5 in Fig.3 show patterns of the mechanisms of earthquakes expected by the model. They represent equal-area projections on the bottom surface of seismic-center globes of push and pull distributions of initial seismic waves radiated from seismic centers. The black portions represent push ranges and the white portions represent pull ranges. One of the lines which border them represents the plane of a seismic fault.

FM1 represents inverse-fault type earthquakes which occur as the Pacific Plate sinks westward as if planning off the

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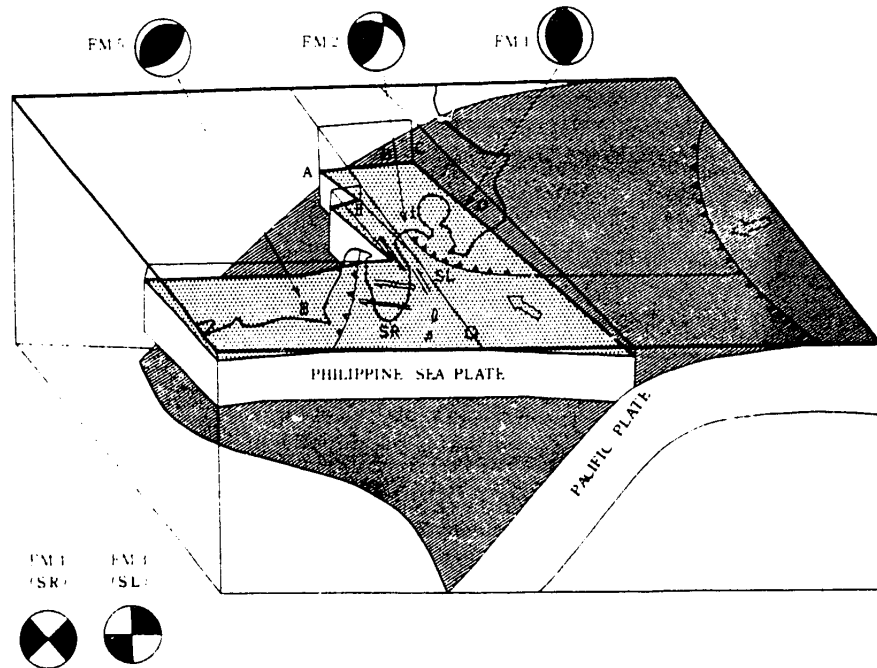


Fig. 3. Systematic Model Which Explains Tectonics in Kanto and Tokai Districts (by Kasahara)

eastern edge of the Philippine Sea Plate. In reality, earthquakes starting at a depth of around 60–90km in the west of Ibaragi Prefecture and in the center of Chiba Prefecture mostly show the mechanism of earthquakes of this type. They also include some of a type which contains prominent horizontal and right sliding components corresponding to the northward slipping of the Philippine Plate.

FM2 represents plate border earthquakes of an low-angle inverse-fault type accompanied by horizontally slipping components, which occur on the top surfaces of the Philippine Sea Plate. The Great Kanto Earthquake of 1923 and earthquakes which started at a depth of around 30–50km in the southwest of Ibaragi Prefecture and in the center of Saitama Prefecture belong in this category. These earthquakes have a main pressure axis extending almost from northwest to southeast and in line with the moving direction of the Philippine Sea Plate. Smaller earthquakes, at a depth of around 30km, which occur frequently in the north of Tokyo Bay show the mechanism of seismic processes of the same type.

FM3 and FM4 represent strike slip type earthquakes corresponding to the Izu Shear Zone. Big earthquakes in the Izu

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peninsula are of this type without exception so far as their mechanism of occurrence is known. Further examples are the Northern Izu Earthquake (M=7.0) of 1930, the Earthquake off the Izu Peninsula (M=6.9) of 1974, the Earthquake in the sea near the Izu Oshima (M=7.0) of 1978 and the Earthquake Easterly off the Izu Peninsula (M=6.7) of 1980.

FM5 shows the assumed mechanism of seismic processes of big earthquakes resulting from sinking of the western wing (III) of the Philippine Sea Plate. Whether or not the mechanism of smaller earthquakes which occur along this line is consistent with the model remains to be further studied.

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SCIENCE AND TECHNOLOGY

OCEAN DEVELOPMENT CREATES DEMANDS FOR MACHINERY INDUSTRY

Tokyo BUSINESS JAPAN in English Vol 26, No 6, Jun 81 pp 71-74

[Article by Riko Nagasaki]

[Text]

VERY great expectations are placed on the development of offshore resources and energy, and utilization of the ocean in general. Not only in Japan, where land and resources are limited, but also elsewhere in the world, ocean development activities have become more active year after year. The number of ocean development equipment constructed throughout the world is increasing annually as countries push ocean development.

In this article, we will take a general look at leading ocean development equipment, such as that related to offshore oil development (drilling rigs and offshore production platforms), offshore plants and work ships. We will also touch on oil fences and rubber fenders which are among the most widely used of all ocean equipment.

Offshore Oil Drilling Rigs

The machinery and equipment necessary for offshore oil development, if categorized as large-sized offshore structures, are divided into drilling rigs and oil production platforms. In the case of Japan, offshore oil drilling rigs are mostly manufactured by shipbuilding companies, while production platforms are constructed chiefly by steel companies.

Japan once was considered as lagging in the technology to construct such offshore machinery and equipment. Now, however, because of the

high quality of their products — a point in common with all branches of Japanese industry — and the strict observance of delivery dates, the Japanese offshore drilling rig industry gradually has earned the high regard of the world oil industry. As a result of the increase in offshore oil development activities, the number of orders received by the industry for offshore oil drilling rigs has been increasing sharply since last year.

The reason why offshore drilling has become active again is that the repeated crude oil price hikes have made viable those oil wells which were regarded as marginal until several years ago.

A study of the number of offshore oil wells in the world shows that there were 2,756 wells in 1978, but the number decreased by about 70 to 2,685 in 1979. In 1980 the number of offshore wells jumped to 3,216, recording an increase of about 530 wells over the preceding year. It is projected that 3,500 offshore wells will be drilled in 1981, 4,100 in 1983 and 4,850 in 1985.

Against this background, the Japanese offshore machinery industry, which boasts superb shipbuilding and steelmaking technologies, has received a sharply increasing number of orders for oil drilling rigs.

Table 1 shows the number of offshore drilling rigs currently in operation throughout the world and the ratio of rigs constructed in Japan.

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Table 1. Offshore Rigs in Operation Throughout the World
(As of February 1981)

Region \ Type	JU	SS	DS	Others	Total
Japan	31	19	12	—	62
World	272	116	53	110	551
Japan's share	11%	16%	22%	—	11%

Note: JU = Jack-up type
SS = Semi-submerged type
DS = Drill-ship type

Table 2. Orders Received for Drilling Rigs
(As of March 1, 1981)

Region \ Type	JU	SS	DS	Total
Japan	25	13	0	38
U.S.	64	2	1	67
Singapore	28	0	0	28
Europe	14	14	4	32
Others	24	10	0	34
Total	115	39	5	199
Japan's share	16%	33%	—	19%

Table 2 shows the orders for different types of drilling rigs received recently. As is evident from this table, Japan ranks second in the world, next to the U.S., in the number of orders received for oil drilling rigs.

Various Equipment Available

Let us next study the trend of major Japanese rig manufacturers.

Among the Japanese rig manufacturers, Mitsubishi Heavy Industries, Mitsui Engineering & Shipbuilding Co., and Mitsui Ocean Development Co., are the shipbuilding companies which have been engaged in the construction of oil drilling rigs from the earliest time.

Without a technical tieup with a foreign manufacturer, Mitsubishi Heavy Industries developed the "Hakuryu Series" of drilling rigs exclusively with domestic technology. Owned by Nippon Offshore Drilling

Co. a Japanese oil drilling contractor, the Hakuryu drilling rigs are operating efficiently at many places in the world. Mitsubishi Heavy Industries' Ju-type rigs are known as MD-J76J and its SS-type rigs as MD502. The Hakuryu VII was launched in early March this year, and Hakuryu VIII is scheduled to be completed in November this year.

Mitsui Offshore Development Co. and Mitsui Engineering & Shipbuilding Co. of the Mitsui Group have developed rigs of their own design — Mode G Series for JU-type rigs, and Modified Foreign Design for SS-type rigs. They have earned a good reputation for these rigs which have been sold to many countries.

Hitachi Shipbuilding Co., too, has developed a jack-up type rig of its own design which it calls "Drill Hope."

Hitachi Shipbuilding and Nippon Kokan K.K. have shown an astonishing increase in the number of orders received, next to Mitsubishi Heavy In-

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dustries and Mitsui Engineering & Shipbuilding. As of March 1, 1981, Hitachi Shipbuilding, in particular, received orders for as many as 12 rigs from various parts of the world. Nippon Kokan received last February an order from Penrod Drilling Co. of the U.S. for two Bingo-model SS-type drilling rigs which Nippon Kokan had developed through a technical tieup with Trosvik Co. of Norway.

Sumitomo Heavy Industries in February this year received from ODECO of the U.S. a first-time order for a large-sized SS-type rig.

As is evident from the above, Japanese offshore oil drilling rig manufacturers are gradually building up their position in the world. They are expected to enjoy increasingly brisk business in the future.

Nippon Steel Corporation and Nippon Kokan are among the leading constructors of oil production platforms, but their market share is still small.

Offshore Plants

Offshore plants as of the end of 1980 totaled 26, of which 15 are power generation plants and the remaining 11, production plants.

The history of offshore plants is still so short that the variety of plants that have so far been constructed is limited. Japanese shipbuilding companies have trial-designed or have planned the following variety of offshore plants. Great expectations are placed on these offshore plants as giant substitutes for ships.

Production plants include methanol plants, phosphorous acid plants, LNG liquefaction plants, alcohol distilling plants, palm oil extraction plants, cement plants, PC pile plants, and steel-making plants.

Other plants include waste incineration plants and refrigeration and cold storage plants.

Work Ships

Twenty-two varieties of work ships have thus far been constructed in Japan, with 3,326 ships constructed in the eight-year period from 1970 to

1977. At 1980 prices, the work ships market in Japan reached ¥485,900 million which comes to ¥60,800 million on the annual average. The average construction cost per vessel was about ¥150 million.

The principal types of work ships are dredgers, crane ships, pile driving ships, rock smasher boats, tugboats, pushers, surveying ships, earth carriers, concrete mixer boats and ground formation improvement ships.

From 1970 to 1979, a total of 1,482 work ships of four different types, namely, dredgers, supply boats, work barges, and work platform ships, were constructed throughout the world. The world work ship market reached about ¥3,000 billion at 1980 prices.

Of the total number of work ships built in the world between 1970 and 1979, 143 worth ¥460 billion were constructed in Japan. Japan's share of the work ships built throughout the world was about 10% as regards the number of vessels but 15% as regards the scale of market.

Oil Fences

The oil fence is designed to prevent the spreading of oil seeping out from oil refineries or oil tankers, to reduce the surface area of oil slicks, and to increase the density of the oil layer in order to make treatment and disposal of oil slicks easier.

There are a great variety of oil fences available to suit different purposes, such as oil fences carried by tankers as part of their equipment, oil fences for permanent installation at fishing grounds or at breeding farms to prevent sea water pollution and floating oil fences that rise or submerge as a ship enters or leaves a port.

There are about 15 manufacturers of oil fences in Japan. Having continued their efforts to develop new materials and to improve the performance of oil fences, these manufacturers today boast the world's highest technology. They enjoy stable exports in terms of value. Applied together with

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oil and water separators, waste oil treatment equipment and oil absorbing material, oil fences are demonstrating great efficiency in preventing oil pollution of sea water.

Rubber Fenders

Rubber fenders are installed along the side of mooring piers in order to protect both the hull of a ship and the pier from the impact that occurs when a ship is berthed. In the case of tugboats, rubber fenders are installed on their hulls.

Therefore, rubber fenders have to have the following characteristics: (1) great shock absorbing characteristics, (2) easy to install and low maintenance cost, and (3) long life and high resistance not only to oil but also to wear, to sea water and to strong sunshine.

Rubber fenders come in a variety of shapes, such as hollow cylinders, square, D-shaped, flat (cushion) and V-shaped. In order to keep up with the recent tendency of ships to become larger and larger, research and development efforts are being made to develop fenders which have greater capacity to absorb shock energy and that have smaller resistance.

Records show that rubber fenders worth ¥4,587 million were exported in 1977. Exports rose in value to ¥4,444 million in 1978 but decreased to ¥3,983 million in 1979. It seems that exports of rubber fenders are greatly affected by the conditions of ports and harbors of each country. □

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SCIENCE AND TECHNOLOGY

FIRST ENRICHMENT PLANT USING CHEMICAL EXCHANGE PROCESS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 58

[Text]

• Asahi Chemical Industry has been licensed by the Science and Technology Agency to use nuclear fuel materials in a uranium enrichment model plant to be constructed in the Miyazaki Prefecture employing a chemical exchange technique. The company is now seeking construction approval from the local authorities, and is expected to begin work shortly for a proposed start-up in fiscal 1983.

Japan's development of uranium enrichment technology has so far been undertaken in one of their national projects by the Power Reactor and Nuclear Fuel Development Corp. focusing on a centrifuge separation method. By contrast, the chemical exchange process, which is suitable for discouraging nuclear proliferation, has lately attracted attention since the Asahi Chemical Industry developed an anion exchange resin with a greatly enhanced ion exchange reaction rate, and successfully produced 1.9% enriched uranium by means of small equipment at its Kawasaki Branch. Observing the substantial benefits of this process, the government began to consider it as complementary to the centrifuge separation process, and, since 1980, has subsidized the company for technical development work.

The projected model plant incorporates four linked enrichment towers each of 1m. effective diameter and 2.5m high, with a capacity of producing 500kg of 3% enriched uranium a year. For six years, from fiscal 1980 to 1985, the government will finance the firm with two thirds of the total ¥12 billion required to obtain economic evaluation data by the end of the period.

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SCIENCE AND TECHNOLOGY

PNC'S URANIUM ORE PROSPECTING

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 59

[Text] The Power Reactor and Nuclear Fuel Development Corp. (PNC) which is carrying out overseas survey and exploitation of uranium deposits has just embarked on its next two targets, namely, Niger (Africa) and the Athabasca district of Saskatchewan, Canada. This makes a total of 20 overseas survey & prospecting projects for PNC. Furthermore, the corporation hopes to realize by the late 1980's a commercial plan to transfer some of its 8 big projects, including Mali (Africa) and the U.S., to the private sector. All these at present are being actively worked on.

The price of uranium has recently fallen somewhat mainly due to a slow-down in nuclear power generation, producing a temporary buyers' market. Notwithstanding this, the global competition for uranium exploitation is intensifying. Even Japan, the second runner in the development race for world-wide uranium resources, is currently earmarking a large-scale budget for overseas survey and prospecting--about ¥5 billion for this fiscal year in the case of PNC.

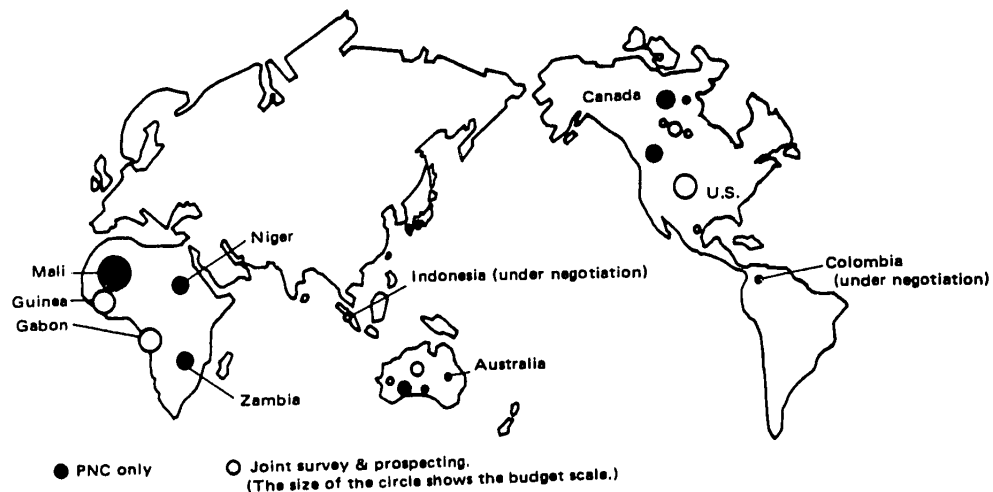


Fig. 1. PNC's Overseas Survey and Prospecting Projects

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All told, nine nations are the subjects for overseas survey and prospecting as shown in Fig. 1. Among them, 8 priority projects now being aggressively developed are those at two districts in Australia, two districts in North America and four African regions, with investment and manpower already up to 80% of the total.

The largest one is at Mali, involving in this fiscal year about 260 workers together with a budget of over ¥1.5 billion for survey and exploitation. In contrast, for the Niger and Athabasca projects beginning in February 1981, ¥200 million and ¥100 million respectively have been allocated.

All this shows that Japan's uranium resources survey and prospecting industry, spearheaded by PNC, is gaining a high momentum.

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SCIENCE AND TECHNOLOGY

SCC STUDY UNDER REACTOR ENVIRONMENTS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 59

[Text] In the autumn of 1974, a water leak accident occurred at a boiling water reactor (BWR) in the U.S. A stainless steel recirculation water pipe had developed hair cracks in the vicinity of welds with residual stress: what is called stress corrosion cracking (SCC). Prompted by this accident, studies on SCC in respect of stainless steel used for BWR have been energetically carried out both at home and abroad. This has yielded a variety of preventive measures with some of them already being applied to actual reactors.

The National Research Institute for Metals investigated SCC in respect of stainless steel under test conditions, simulating the situation of a BWR in constant operation. This revealed for example that the stress of a pipe working in both peripheral and longitudinal directions could cause cracking more frequently than if it was only in a peripheral direction.

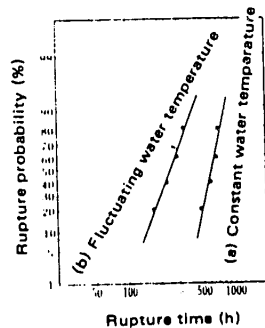


Fig. 1. Logarithmo-normal Plotting for the Rupture Life of 304 Stainless Steel Under BWR Conditions

Meanwhile, in actual reactors, the number of cracks occurring seemed to correlate significantly with the functions of reactor startup and shutdowns. This necessitated experiments to reproduce such operating conditions in addition to normal-run simulation. Accordingly, the institute picked up as a specimen the same stainless steel material as used in existing reactors. The specimen material underwent heat treatment so as to develop cracks and provide a similar crystal structure to the heat affected zone. Employing a circulation testing facility of high-temperature/high pressure water, the treated specimens were tested under more severe conditions than those during startup or shutdown of normal reactors. From the factors examined, the repetitive temperature change contributed most to the production of cracks.

The graph shows the effect of water temperature on the rupture life under constant stress and dissolved oxygen concentration. The average rupture time was 600 hours for case (a) when the water temperature was held at 290°C to simulate a steady-rate operation, whereas it decreased to 250 hrs. in case (b) when the water temperature fluctuated in the 145-290°C range. Thus it was found that cracking in a BWR is also promoted by water temperature changes during startup and shutdown.

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SCIENCE AND TECHNOLOGY

SUBMERGED CUTTING OF STEEL PLATES FOR NUCLEAR REACTOR PRESSURE VESSELS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 88

[Text]

• The Government Industrial Research Institute, Shikoku, has recently developed a new "method of submerged cutting of pressure vessels for nuclear reactors", which is unprecedented in the world and which has succeeded in submerged cutting of 15cm thick stainless steel clad plates by using a new cutter.

The largest thickness ever cut in water of stainless steel clad steel plates used for pressure vessels for nuclear reactors has been recognized to be 7.6cm, which was recorded when the Eric River Reactor of the U.S. was dismantled. The new system has nearly doubled this thickness.

When dismantling and removing 1 million kW class nuclear reactors, it is necessary to cut

about 20cm thick stainless clad steel plates in water. The new method of submerged cutting has, in principle, no limit to its cutting thickness. It successfully cut in the air a 44cm thick steel plate. Thus, the institute believes that it is not technically implausible to cut pressure vessels, which has been the largest difficulty in dealing with redundant reactors.

There are more than 10 different types of submerged cutting. The new system is different from the conventional types but uses a submerged gouging system and a submerged gas cutting system combined. In detail, it first blows the stainless clad away, by using the submerged gouging system, to expose the steel base and then cuts the steel by applying the gas cutting system.

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SCIENCE AND TECHNOLOGY

TESTING, INSPECTION USING ELECTRIC, ELECTRICAL EQUIPMENT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 26-30

[Article by Shigeo Sakai and Kazumasa Nakamura, Second Design Section, Automation Equipment Division, Fujitsu Ltd.]

[Text]

In recent years, the introduction of automation and other labour-saving methods to test inspection processes has begun to be recognized as a very important task. This recognition has arisen as a corporate response to cope with the problems of high sophistication, increased complexity, and high reliability accompanying the rapid technical innovation that has taken place in recent years, as well as to cope with rapidly spiralling personnel expenses and shortages in the labour force. Automation in testing and inspection processes takes various forms depending on a company's individual needs, but the scope of its application is expanding widely owing to advances in measuring technology.

One of the factors demanding automation and labour saving is changes in the features of products brought about as a result of rapid technical innovation that has taken place. That is, to meet demands, products have to have undergone or have, high integration, miniaturization, mass production, high reliability, extended life, various and multifunctional capabilities, and these have given the inspection and testing processes the following effects:

- (a) Increase in the number of items that need to be tested and inspected.
- (b) Increased accuracy and faster inspection and testing.
- (c) Inspection and testing of a large variety of products and collection of the data over a long period.
- (d) Requiring that testing and inspection machines have general-purpose features and increased flexibility.
- (e) Increased demand for skilled test engineers, resulting in expanded manpower requirements.
- (f) Increase in the number of test and inspection processes.

On the other hand, the objective of automation is to gain much greater benefits by overcoming the limits of man's capabilities and by liberating him from an inferior environment

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and adverse conditions. It is said automation has the following effects:

- (a) Higher speed.
- (b) Elimination of human errors.
- (c) Increased freedom from the effects of surrounding environment.
- (d) Increased uniformity and reliability in the quality of products.
- (e) No interrupted operation, free from fatigue no idleness.
- (f) Broader diffusion of skills and technology, shortened hours for training.
- (g) Relief from simple work.
- (h) Early acquisition of process information.
- (i) PR effects
- (j) Ease of maintaining products at the work site.
- (k) Increased will to work, elevation in the consciousness for automation and rationalization.

The above are generally what result from automation of inspection. In the following the writers will describe, step by step, automation in test and inspection processes in the field of electronic and electrical equipment in our company.

1. Test and Inspection Using Electronic and Electrical Equipment

Equipment that becomes the target for inspection and testing by electronic and electrical devices is broadly divided into parts, modules, units, equipment, and systems. Among parts are included circuit parts, such as resistors and condensers, mechanism parts such as relays, switches, and connectors, oscillating parts such as quartz-oscillators and mechanical filters, semiconductor parts such as IC's and LSI's, hybrid elements, and memory stacks.

Among modules are included theory printed-circuit boards, analog printed-circuit boards, and memory stacks. The boundary between units and equipment is not clear, but in computer systems, for example, memory devices, channel control devices, I/O devices, and terminal equipment are counted as being units. Systems, of course, come in various forms and types.

The content of these objects for measurement is broadly classified between electrical characteristics and functional inspection. They are volt-ampere, frequency, impedance, electric power, phase, output pattern, etc., and evaluation is made by giving an object to be measured some kind of stimulus and measuring the response to see whether the response meets certain standards.

Among such testing and inspection machines are included IC testers, printed substrate testers, printed board package testers, wiring testing machines, printer characteristics testing

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machines, radios, and transceiver automatic testing systems. Most are computerized and have data compilation, statistical processing, and interference analysis conducted according to procedures controlled by a memory program.

The demand has further heightened in recent years from merely seeking automation in the field of testing and inspection, to seeking total efficiency, such as automation in receiving and dispensing work of various kinds of information through on-line links between floor control systems, and production control and manufacturing departments. As an example of automation coping with this demand, a central control system in the testing and inspection process of printed board units is introduced in the following.

2. Central Control System in the Testing and Inspection Process of Printed Board Units

Because of their high integration and increased performance, printed boards for computers have in recent years, begun to come in various forms. As a result, the production lines have turned to production of various kinds of products in small lots, thus further complicating the difficulties of control and prior preparation.

Testing and inspection facilities, and equipment, have come to take on various functions and thus they are expensive. Accordingly, automation has come to be sought for reasons

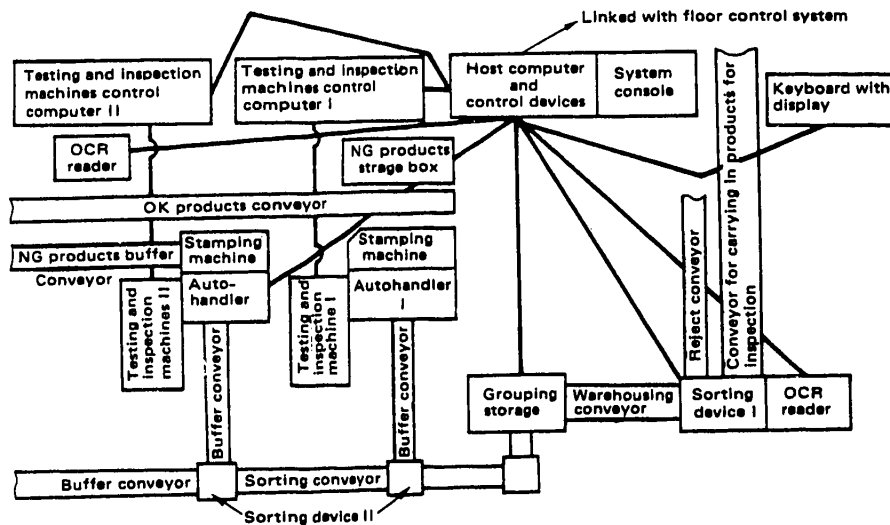


Fig. 1. Equipment Comprising the System

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not only for the better utilization of existing facilities and to cope with increased installation of facilities to handle increased production, but also because of increased personnel expenses. These demands have been met by the central control of existing automatic testing and inspection equipment. By analyzing operations had points of control in each process, these functions have been replaced by machines, and an automation system has been devised whereby existing equipment is put to the maximum use.

Conditions demanded of this system are as follows:

- (a) Automation in planning operation.
- (b) Effective utilization of existing testing and inspection equipment.
- (c) Labour saving through extensive adoption of automation equipment.
- (d) Central control of various kinds of equipment and instructions.
- (e) Substantially enhanced process control.
- (f) Substantially enhanced reporting functions.

3. Outline of System

This system is composed of the equipment shown in Fig.1, and the specific features incorporating new techniques and their automation are listed below:

- (a) Application of an OCR automatic reading device for the equipment.
- (b) Adoption of group storage based on group technology and development of software.
- (c) Development of autohandlers I and II.

With this system, all operations from entering a sample to shipping, are all conducted by computer-controlled machinery. In explaining this system's greatest feature, automation, this article describes in detail the newly developed grouping storage, and autohandlers I and II.

3-1. Grouping Storage

Grouping storage is a system in which in order to raise the efficiency of a multiple number of automatic testing and inspection machines, the same type of units, out of units stored at random, are sorted for feeding, according to a schedule, to each testing or inspection machine.

As shown in Photo 1, the grouping storage is composed of a magazine, unit storage and unit take-out sections. The magazine section has a unit storage section provided with 540 slots. Each slot has its own number, and selections involving storage or taking-out of units are all performed by computer. The driving mechanism employs a D.C. servo-motor drive system. In order to raise efficiency, it is designed so that it can

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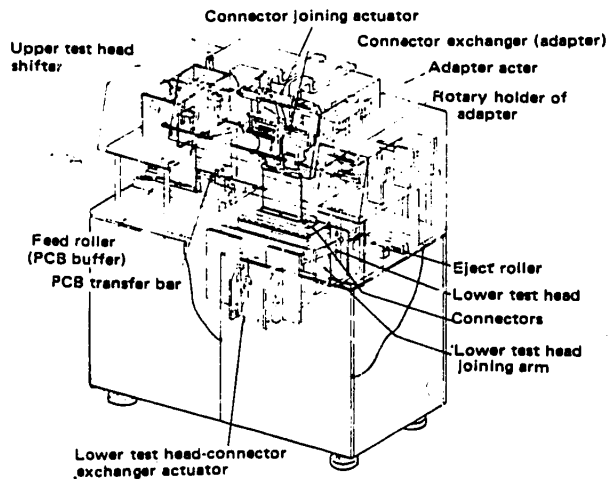


Fig. 2. PC Board Autohandler

rotate in both directions. It of course incorporates control mechanisms that speed up or slow down rotation at the start or stop of the motor. The storage and take-out section has an auto-hand installed on an elevator.

3-2. Autohandler

Attaching a unit or test-piece onto an automatic testing or inspection machine or taking it off, requires about 15kg of power since the connector terminals are numerous. Requiring human hands to execute such work in large volume for long hours entails difficulties. Therefore, automation has been introduced into a series of jobs involving attachment and detachment of units, sorting of accepted products and rejected products, stamping of seals certifying completion of tests etc. By shape, printed board units can be classified into single-kind multiproduct and multikind multiproduct categories. Therefore, after taking into account the capacity of an automatic testing or inspecting machine, and the economics of a handler, two types of machines were developed. The handler comprises the attachment and detachment, stamping, sorting of accepted and rejected products, and storage of rejected components.

(i) Autohandler I

This is equipment designed exclusively for processing mass-produced printed board units of the same shape. One feature is that it operates by alternate actions of an attachment hand and a detachment hand.

(ii) Autohandler II

This equipment is designed for processing various shapes of printed board units. An external view of this equipment is shown in Photo 2 and Fig.2.

- (a) The shape of printed substrates - 6 kinds
- (b) Back panel connectors - 3 kinds

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- (c) Combination of front side connectors – $12 \times 12 = 144$ kinds
 (d) Kinds capable of theory processing – $6 \times 3 \times 144 = 2.292$ kinds

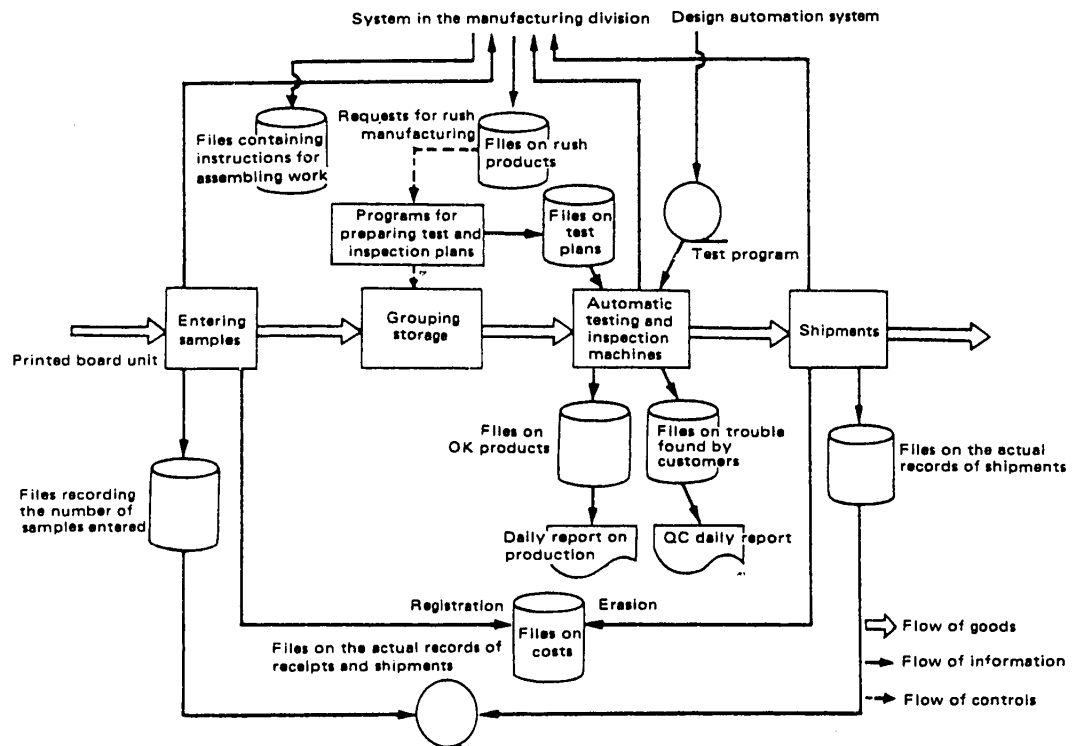


Fig. 3. Outline of Information Processing

As mechanisms giving it the capacity to cope with 6 kinds of print substrates, the handler has an automatic selection of positioning pins to width direction and an automatic adjustment to the direction of height.

To the back panel side, 3 kinds of connectors are arranged in a row for automatic selection. To the front side connector, an arrangement of 12 kinds of connectors in a radial manner is provided in duplicate, and automatic selection of their combinations is employed.

All of these orders are given by computer.

3-3. Composition of Software and Its Functions

An outline of information processing by this system is shown in Fig.3. Composition of software and file composition are shown in Figs.4 and 5.

Features of the software are as follows:

- Reliability has been enhanced by providing joint processing with a thorough subroutine.
- System reliability has been enhanced by giving various

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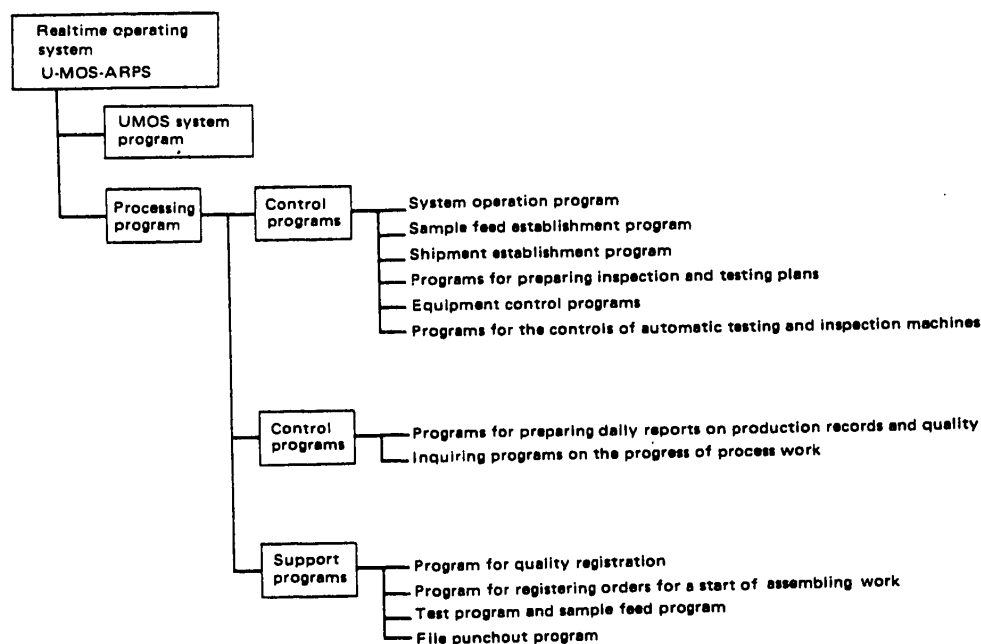


Fig. 4. Composition of Software Equipment

equipment functions to dispose of abnormal operations and restore them to normal state, or by giving them functions to prevent operational errors.

(c) Since unmanned operation has been introduced, a system monitoring program has been prepared to prevent various equipment and instruments from being in a state of suspended operation for any great time.

(d) Flexibility has further been increased in system interchangeability.

3-4. Features of the System

(a) Printed board units in numerous varieties can be input piece by piece in any sequence.

(b) Automation is effected in the planning of a schedule, and transportation and distribution, so that the automatic testing and inspection machines can have maximum efficiency.

(c) By the adoption of authohandlers, system operation has been made possible unattended.

(d) Instructions can be given to a large number of automatic testing and inspection machines by monitoring them centrally.

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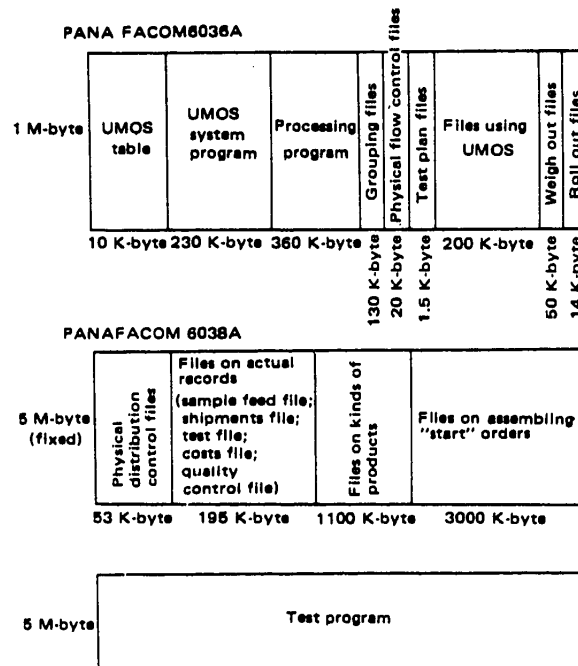


Fig. 5. Composition of Files

- (e) Being provided with collection of information on operation, quality, and report functions, the system can use such data for feedback purposes.
- (f) Process control is further enhanced by the adoption of sample entering and shipment controls in the entire field of the printed board testing and inspection process.
- (g) Receiving and dispensing of various kinds of information with other systems can be had by connecting this system online with them.

4. Future Trends and Developments

With diversification in the kinds of products, and the greater multifunctional capabilities of these products, automation in testing and inspection will become an ever more important task in the future. Consequently, the important problem will now be to cope with the production of various kinds of products in small quantities. With the costs of equipment being in the direction of getting even higher, an

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attitude is required of the users of such equipment to face such developments in a systematic way, to include effective utilization of existing equipment. This trend is expected to increase in particular in the testing and inspection field of electronic and electrical instruments and devices. Consequently, the need for development of automation equipment provided with multifunctional versatility will further increase.

We shall be happy if the idea of incorporating into a central control system the testing and inspection of printed boards as in this paper, is of any service to readers.

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SCIENCE AND TECHNOLOGY

COMPUTER MAKERS COMPETE OVER MARKET FOR OFFICE AUTOMATION EQUIPMENT

Tokyo CHUO KORON in Japanese Vol 20 No 3 Summer Issue 81 pp 148-158

[Article by Yukio Shimura, a journalist focusing on technical subjects]

[Excerpts] Emergence of Japanese Word Processors

In the United States, English word processors have become widely used in the last few years. However the development of word processors has tended to be slow in Japan due to the difficulties in handling the language.

As if to make up for the delay once and for all, more than 15 manufacturers are planning to exhibit their word processors at the coming 56th Business Show. Among the computer manufacturers, Shibaura Corp (Toshiba), Fujitsu, Nippon Electric Co and Oki Electric Industry Co, which make up the early starter group, along with the newcomers, Hitachi, Ltd and Mitsubishi Electric Corp, will be the major participants. Among the business machine manufacturers, the older contenders, Sharp, Cannon and Pentel will be joined by late starter Ricoh, and early starter Matsushita Communication Industrial Co and new participant Yokokawa Electric Works as the major representatives of the communications and measuring instruments makers. Expectations are growing as rapidly as the number of manufacturers. One can hear them talk about "large scale products appearing in the office automation (OA) market after a long absence" and predictions that their 5 to 6-billion-yen business of 1980 will be sure to expand into a 100-billion-yen market in the 1980's. Prices of their word processors vary from a little less than 2 million yen to close to 5 million yen, but the majority of them fall within the 2 and one-half to 3-million-yen range, which is lower than office computers.

Those new to the market are seeking an expansion in their business and all manufacturers are starting to vie aggressively with one another for a larger market share.

Toshiba, the oldest contender in this field, sold a total of 1,270 word processors, between February 1979 and March 1981. This year, they plan to sell 2,100, twice the number of last year. General Manager of the Office Automation (OA) Department, Koichi Kikuchi, showing his high motivation, says, "I want to nurture and strengthen the word processors division as the fourth batter on our OA team."

Since Sharp entered the market after Toshiba at the end of 1979, they have sold between 1,200 and 1,300 machines. Sharp's Executive Director Tobe does not

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hesitate to assert that they are the top manufacturer at present. They are determined to attain the irrefutable position as top contender this year, with their goal set at selling 200 units a month.

Fujitsu joined the market in the middle of 1980, setting their goal at selling 6,000 units in 3 years. They have had a good start. In the following 6 months, from the middle of 1980 to the end of March, 1981, they sold 1,024 machines. At the beginning of April of this year, at Fujitsu's Office Automation Machines Sales Promotion Headquarters located in their Onarimon Annex, Sales Promotion Manager and Managing Director Yoshisaburo Nakanishi painted in the second eye of an one-eyed Daruma doll in order to commemorate their success in selling over 1,000 units. Mr Nakanishi, very pleased, said, "We have been surprised at the big response we have received since we put our products on the market. Word processors, no doubt, will be our core product in the future."

Other makers, too, while looking askance at those major manufacturers, are developing an aggressive strategy to seek a bigger share of the market. Nippon Electric raised their average monthly sales to over 100 units from the sixties level of last October. Cannon, which started shipments this March, has already revised their initial plan of 50 a month to 100. Hitachi, which joined the market as recently as April, is planning to push hard to sell 1,000 during the second half of 1981 and 3,000 in 1982. Chief of Hitachi's OA Promotion Headquarters, Masanori Ozeki, very confidently says, "This market is still very young. It is nonsense to say that latecomers have disadvantages. Our products can satisfy well the functional needs of users."

This feverish contention surrounding the word processors seems to illustrate symbolically the vitality and the future possibility of the still young OA market.

Higher Efficiency Among Office Workers

It is indisputable that the goal of office automation is to assist people and bring efficiency to office work. According to a survey conducted by Nippon Electric, most of the office workers spend 40 to 50 percent of their time in meetings and making preliminary arrangements with other workers. When office and telephone conversations are added to this, time spent on irregular forms of communication amount to 80 percent of their time. Of course, not all of this is wasted time, but since time is money, higher efficiency in communication is strongly hoped for.

Low rates of office productivity growth, compared to that of factories, are also a problem. According to data collected by SRI (Stanford Research Institute), in the past 10 years between 1968 and 1978, productivity in manufacturing has risen 90 percent while office productivity has risen only 4 percent. This wide gap is a result of factories receiving priority investments and the slow development in office automation equipment. My day to day experience assures me that this is also true in Japan. This being the case, it is an urgent task to attain high efficiency by turning a present labor intensive office into a mechanized, automated one.

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The first phase of this office automation process will be supported by single, mono-functional products, such as copy machines, facsimiles, microfilm machines, office computers, personal computers and word processors. These will later be connected to compound, multi-functional products (system) in the second phase and be incorporated into a total system in the third phase. If the stand alone type (independent type) of word processors in use today are connected by communications circuits and can output through a facsimile in a different location, we may call that the second phase. Furthermore, if they can be hooked into a national network and used as an electronic mail service, that will be the third phase. "The age of office automation is not something for the future. It has already started and will continue," says Nippon Electric's Watanabe.

We cannot overlook the fact that the core technology which supports the system technology has been nurtured under similar circumstances. The major representative of this core technology is semiconductors. As the integration process has moved from IC (integrated circuit) to LSI (large scale integration) to Super LSI (super large scale integration), logic and memory costs have been reduced 25 and 40 percent respectively each year. As Ozeki of Hitachi points out, since "present office machines are nothing but a mass of semiconductors except for their skin," there is no doubt semiconductors will have a great impact on the process of miniaturization and price reduction.

Unsettling Office Automation Equipment Industry in Chaos

As I surveyed the OA industry, the first impression I received was that it is in a state of chaos with a big goal ahead of them. By this "chaos," I of course do not mean a kind of panic that rises when the end is near. Rather it seems to be a reflection of a movement toward creation and the pain of giving birth.

In regards to OA equipment manufacturers or the OA industry, we still do not have a specific maker which we can refer to as "the" OA equipment manufacturer, since the industry maintains a strong, independent and divergent tendency at the present stage. As a matter of fact, many of the office computer and word processor manufacturers were originally computer manufacturers and they still are. Facsimiles, so far, have been produced by communications equipment makers and will probably remain so in the future. Copy machines belonged to the territory of business equipment manufacturers. Outsiders will call them either "copy machine manufacturer" or "business machine manufacturer." One of the reasons for this, I believe, is that the present stage of office automation is still geared towards single, separate units and has not reached a compound, systematized level.

I have an interesting example of the "divergent tendency" which I mentioned earlier. I asked Nippon Electric, which adopted the slogan "C & C Office," to list all the departments that are related to OA equipment. They came up with almost 10. They were: Domestic Machines Dept and Private Communications Dept which handle telephone systems; Facsimile Dept which handles facsimiles; Information Processing Systems Dept which handles computers; Personal Computers Dept which handles personal computers; Terminal Equipment Dept which handles word processors; Transmission Communications Dept which handles modems; Mobile Communications Dept which handles pocket bells; and Picture Broadcasting Dept which handles television monitors for stores. Surprised at this fact, Watanabe mentioned, "I intentionally

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did not include large computers and mini computers, but most machines manufacturing departments seems to be related to office automation."

This divergence is found at Hitachi also. At Hitachi, to list a few, the Computer Operations Dept handles office computers; Communications Equipment Dept handles facsimile; Product Operations Dept handles word processors; and the Domestic Electric Equipment Operations Dept handles personal computers. The fact that the Product Department, originally in charge of pumps and motors, now handles word processors seems to be stretching it too far.

OA-related manufacturers are preparing for the advent of a full scale OA trend. Armed with strategies that involve all departments of their operations, they are trying to revise a present "vertical" stage of independent, diversified units by totally and organically combining them in an integrated fashion. These efforts have been manifested in the establishment of OA Promotion Divisions among major manufacturers in the last couple of years.

Ozeki, who is in charge of the OA Promotion Division at Hitachi (Established in August 1980) says, "Each one of our factories is technically strong. Our role towards achieving total office automation is to develop a solid integrated relation among them while enhancing each one of their strengths." Toshiba also established an OA Operations Control Division in November of 1980 and has so far played the role of a scout in market development. The objective of their plan is Goal A (Automated Office). Their strategy is to approach it from three different directions, B (Business Machine), C (Communications System) and D (Data Processing System). (See Figure 1)

Key:

- A. Automated Office
- B. Business Machines
- C. Communications System
- D. Data Processing System
- 1. Facsimile Multiple Address Equipment
- 2. Multi-Work Station Office Computer
- 3. Office Automation Pilot System
- 4. Voice Typing
- 5. Office Computer equipped with OCR (Optical Character Reader)
- 6. Office Computer equipped with word processing function
- 7. Japanese Word Processor
- 8. Picture Information File
- 9. Facsimile
- 10. Store Online System
- 11. Office Computer. Mini Computer. Terminal Equipment
- 12. Hiragana OCR
- 13. 500 Characters per Second OCR
- 14. PPC (Plain Paper Copier)

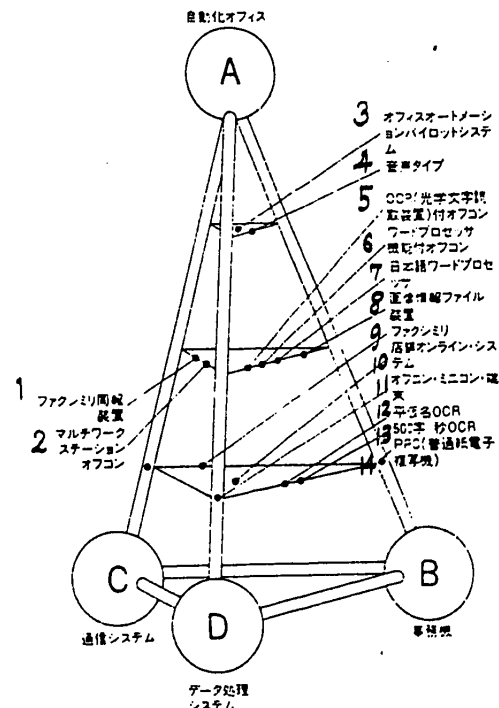


Figure 1. OA Structure

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Mitsubishi Electric also opened an OA Project Room in November of 1980. Chief Kiyotake Sakaki says, "Our present responsibility is to map out operations strategies and to engage in marketing activities." In their operations, Mitsubishi is planning to construct a total OA system by organically combining technologies of three different fields referred to as "3 D," Document Processing, Distributed Network and Data Processing.

Many manufacturers have gone beyond just forming strategies. They have started incorporating sales in their plans, thus unifying their OA promotion programs. One example is seen at Fujitsu. Nakanishi, in charge of the OA Equipment Sales Promotion Division (established in June 1980) says, "We will take the role of controlling the OA Equipment Manufacturing Divisions (Electronics and Communications Equipment Divisions). At the same time, we will go beyond into direct sales promotion." He also added that they have already been successful in the sales of building management systems centered around private branch exchanges.

Oki Electric, for the last 3 years, has been working on what they call a "Strategy for Many and Unspecified Market Products" simultaneous with sales of large systems for big corporations. OA equipment has played a central role in this strategy. Also as a part of it, the Information Processing Department within the OA Systems Division was established. Hopeful Matsuda, Chief of the new division says, "Although we will keep on emphasizing the sales of single units, we would also like to direct ourselves towards the sales of systems that cross over and incorporate both electronic communications and information processing territories."

Although the OA market is based on existing equipment, for some reason, it is filled with the spirit of new life. I suspect it is partly due to the fact that at this moment, manufacturers have finished developing their concepts and have completed forming their strategy and re-organization.

Inter-Industrial Trend

While manufacturers are re-organizing their departments to achieve an integrated structure for dealing with office automation, they are also moving into other product territories making OA industry more complex and intricate. This has been another noticeable phenomena in the development of office automation. Business machine manufacturers launching into computer fields and, the reverse of this, computer and communications equipment makers moving into the copy machine field demonstrate this inter-industrial tendency, which the expanding OA market and the development of its system will fuel further in the future.

As another indication of this trend, I can point out that many joint ventures are being formed among manufacturers of different products. Ricoh, essentially a business machine manufacturer, will be provided, by computer equipment manufacturer Nichiden, with an OEM facsimile multiple address system (Equipment which transmits stored information to more than one destination in a single operation). To reciprocate, they will provide their own DG wheel for impact printers (as against IBM's golf ball shaped printer, their's comes in disc form) to Nippon Electric and other major manufacturers. Ricoh's managing director, Hamada says, "We have communications technology we acquired through having developed facsimiles but we do not make communications equipment nor switchboards. It makes sense to

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take advantage of each other's strengths to achieve a higher quality/price ratio in one's product."

Among the Matsushita Group, Matsushita Electric Industrial Co copiers and computers, Matsushita Communication Industrial Co makes word processors and Matsushita Graphic Communication Systems facsimiles. This indicates more a divergent type of development. However, the online OCR facsimile, which Matsushita Graphic Communication Systems disclosed recently, is, as Yuzuru Tanaka (Director and Chief of Facsimile Kenkyujo--Research Institute) describes it, like a "composite product made by different divisions within the group." Basic technology for this OCR for handwritten material was developed by Matsushita Electric Chuo Kenkyujo, while Matsushita Communication Industrial Co handled the part of engineering the apparatus. This system, by the way, is an epochmaking one where one can put handwritten OCR data such as books and other forms with figures directly into a computer using the normal transmission through facsimiles in branch offices and operations centers.

I have so far mentioned that OA equipment manufacturers are becoming domestically divergent and at the same time are shifting towards inter-industrialization. While these trends suggest that the OA-related market will follow a basic principle of expansion, they make one's assessment of it very difficult. This is because, as I have mentioned earlier, "OA equipment" incorporates various machines and systems and overlaps with already existing industries. Figure 2 indicates the positions of major pieces of equipment which are so called "forerunners of OA." Except for copy machines, production of all equipment takes place near the border of each industrial territory.

Of all the equipment included in Figure 2, copy machines represent the largest production followed by office computers and facsimiles. The total production of those three items is 600 billion yen and is used as a barometer to measure the size of OA industry. Personal computers and word processors have not been on the market long, therefore the figure is small. Interestingly, in the United States, contrary to Japan, word processors make up the largest market but they sell few facsimiles. Sakaki of Mitsubishi points out "it is because of the functional difference between a 'typing race' based on alphabets and 'handwriting race' based on Kana and Chinese Characters."

I quoted earlier that OA equipment production to be 600 billion. However, if all OA-related equipment were included, the amount would easily exceed 1,000 billion yen. As a matter of fact, one major computer manufacturer has figured out that the production of OA-related equipment from various departments totaled 130 billion in 1980.

If this is true, it means OA equipment has established a large market equivalent to that of computers and is something that cannot be ignored.

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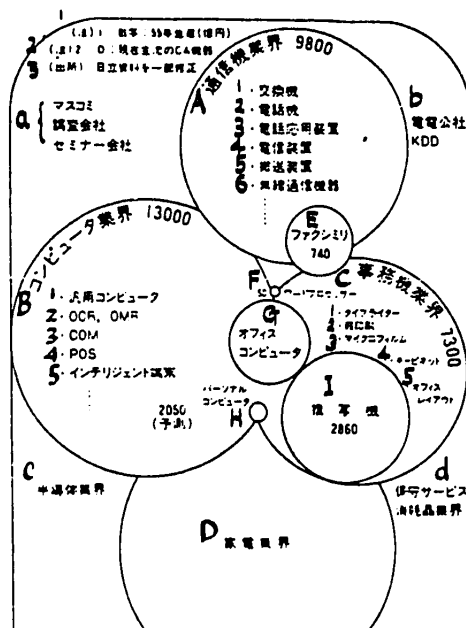


Figure 2. Development and Output of OA-Related Industries in Japan

Key:

1. Figure: 1980 production (100 million)
2. 0: Major OA products at present
3. Source: Partly revised material obtained from Hitachi

- | | |
|---|---|
| <p>A. Communications Equipment Industry 9800</p> <ol style="list-style-type: none"> 1. Switchboard 2. Telephone 3. Telephone application equipment 4. Telephone & telegraph equipment 5. Carrier equipment 6. Wireless communications equipment | <p>B. Computer Industry 13000</p> <ol style="list-style-type: none"> 1. Mainframe computer 2. OCR, OMR 3. COM 4. POS 5. Intelligent terminal 2050 (estimate) |
| <p>C. Office Business Machine Industry 7300</p> <ol style="list-style-type: none"> 1. Typewriter 2. Light printing 3. Microfilm 4. Cabinet 5. Office layout | <p>D. Domestic Electric Appliance Industry</p> <p>E. Facsimile Industry 740</p> <p>F. Word Processor Industry 50</p> <p>G. Office Computer Industry</p> <p>H. Personal Computer Industry</p> <p>I. Copy Machine Industry 2860</p> |
| <p>a) Mass Communications Research Firms Seminar Companies</p> <p>c) Semi-Conductor Industry</p> | <p>b) Nippon Telephone & Telegraph Co
Kokusai Denshin Denwa (International Telephone & Telegraph)</p> <p>d) Maintenance Service Supplier Industry</p> |

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Japan Becoming a Strong Contender

Takuma Yamamoto of Fujitsu, at a press conference in late March, announcing his nomination to be the new president, talked about his future expectations. "Up to now, we only had to follow the mentor IBM. From now we have to develop our own path in terms of business and technology." For that purpose, we will make the development and sales of OA-related equipment a top priority, so that in the future it will follow the patterns of computers and communications equipment departments and become another pillar of the industry."

This comment by Yamamoto shows Fujitsu's strong determination and convincingly predicts the arrival of the OA era. His comment also shows a great deal of confidence on Fujitsu's part that it will not yield to IBM. As a matter of fact, Fujitsu surpassed IBM in sales of computers in Japan. Now that the first hurdle has been crossed over, they are ready to compete with IBM in the new OA market. Fujitsu has an advantage over IBM in communications technology, which is a key to this new market. They also have an edge over IBM in the field of small and super small computers. In developing their marketing strategies, Fujitsu is planning to take full advantage of the big competitor's weaknesses.

At the same time in the United States, Japanese products have an excellent reputation, as industrial analyst B. Rosen points out, "When compared within the same price category, Japanese personal computers are of better quality than U.S. products." Additionally, the conclusion of a recent survey conducted by University of Southern California warns that the personal computer industry, too, like auto, steel and the television industries, will face fierce competition from abroad.

It might be a reflection of this upcoming strength that I heard so many top executives mention that "Japan is strong" during interviews for this report.

The point most frequently raised was the superior quality of Japanese products. Hamada of Rocoh, a reputable copy machine manufacturer, maintains, "In the high speed machine field, we still cannot match Xerox, but in more popular models we have the biggest share in the world market. It is because our machines are reliable and therefore need few repairs." Kazuya Watanabe, Chief of Personal Computer Department at Nippon Electric, emphasizing the high quality of Japanese products, says, "Eighty percent of the demand for personal computers today is in business. Japanese products definitely need fewer repairs therefore keeping the maintenance cost down." It goes without saying that this superiority in quality is achieved through production techniques, including mass production, and the uniquely Japanese Total Quality Control (TQC) that involves all departments of the company.

We must also remember that Japanese Kana and Chinese Characters are contributing to the development of this unique technology. As is often pointed out, Japanese do not use a phonetic alphabet, but use ideographic Chinese Character which come in much larger numbers than the 26 letters of alphabets. Japanese language also has many cases of the same sounds with different meanings, making computer input and communication difficult. As a result of this, facsimiles, copy machines and picture information files, where characters are treated as patterns or pictures, have developed a great deal. Tanaka of Matsushita Graphic Communication, the

foremost facsimile maker, confidently says, "Maybe not for the communications use yet, but Japanese production of facsimiles for business use have reached the level of the United States. These days, there are more cases of Americans importing technologically advanced machines from Japan."

Japanese word processors, which are rapidly gaining popularity now, also deserve mention as a product of technological advancement that conquered the difficulties of handling a language which uses many ideographic characters. At present there are the following types of Japanese word processors on the market.

1. Tablet method system where Chinese Characters are fed directly from the keyboard.--Sharp and Nippon Electric manufacture this type.
2. Kana and Chinese Characters transforming system where Kana is typed in and some of them are automatically changed into Kanji. (Chinese Characters)--Toshiba and Fujitsu make this type.
3. Alphabet input type where romanized Japanese is typed in and are automatically changed to part Kanji.--Cannon manufactures this type.
4. Association method type where each Kanji fed in is given two different readings.

This active and diversified development is a result of the efforts on the part of the manufacturers that made the technology to handle the unique Japanese language. Naozo Yamamoto, Chief of OA Operations Control Division at Toshiba, with high expectations for Japanese word processors, says, "It took the United States 40 to 50 years to realize the use of word processors. In Japan it is starting to bloom all at once now that the basic technology has been achieved.

Another characteristically Japanese approach is that the manufacturers are quick to respond to many different needs of the users. Let us take the case of office computers. There are many types of computers developed specifically to meet the different needs of, for example, accounting, medical and legal offices, agricultural co-ops and beauty shops. There are Kanji office computers, and system component computers which make additions and parts change possible by separating memory, display, keyboard and printer parts. Ricoh makes this type. This undoubtedly is "the product development that scratches where it itches" as Sakaki of Mitsubishi points out.

Now when total systemitization of office automation equipment is sought for, it will become one of the strengths that major Japanese manufacturers are equipped with different technologies that incorporate the fields of computers, communications equipment and semi-conductors. Watanabe Yasushi of Nippon Electric boasts, "Every one of our OA-related equipment is at the world's top level. What supports it is the world's highest technology in IC and fiber optics." Ricoh and Cannon, which have been basically business machine manufacturers have embarked on the trimming of ICs. This can be noted as an indication of their policy to strengthen their line of OA equipment. But for those makers to operate at full capacity, "Completely free and open communications network as in the United States will be a prerequisite," says Ozeki of Hitachi.

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Professor H. L. Morgan of University of Pennsylvania said, "Japan is about 5 years behind the United States in office automation." As we look at the situation, this comment, although it might have some truth in it, seems like an illusion.

I have to say that Japan is posing a challenge in the new stage called "Office Automation."

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SCIENCE AND TECHNOLOGY

ON-LINE MEASUREMENT INSPECTION CENTERED ON AUTOMATIC SORTING SYSTEM

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 22-25

[Article by Masahiko Fukazawa, Meiji University professor]

[Text]

1. Inspection and Measurement

Inspection involves the process of ascertaining whether a lot of works are within the designated tolerances and determining whether they are to be accepted (OK) or rejected (NG). Measurement, on the other hand, is the process of showing the measurements of a work in numerical values, or recording the shape or the surface roughness of a work on a recording medium.

Tolerances for a work are established to permit interchangeability of like parts. Limit gauges are an example of a device to inspect mass produced works, and a micrometer is often used for small-lot production. Determining whether a work is within tolerance is therefore a combination of measurement and inspection.

These are only general concepts, however, and there is no clear boundary between inspection and measurement. Some people refer to inspection and measurement as only measurement, while other people lump the two functions under inspection. Targets of inspection include raw materials, purchased parts, and final products, but this article is centered mainly on individual works.

2. Automated Measurement

Automated measuring is required in the following cases.

- (a) Where increased automation of manufacturing systems require a more advanced automated measuring system.
- (b) Where automated measuring is required for very high speed operations.
- (c) Where automated measuring is needed because of the nature of the process (such as requiring remote control), or because of the shape or measurements of the objects to be measured (for example, very small objects).

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(d) Where reduced energy use overhead, and margins of error caused by operator fatigue are sought.

When talking about automating a measuring process, automation alone does not mean much unless it is accompanied by automation in associated areas, such as obtaining quality control information, and establishing prescribed processes for different quality levels of works. Feeding, loading, and removal of objects to be measured must also be automated.

Depending on the situation, complete automation may cause more problems than it solves, therefore semi-automation in measuring processes using some manual work may be a required step of full automation processes in the future.

Automation in measuring contains part or all of the following elements.

- (a) Measurement
- (b) Judgment (OK or NG)
- (c) Conveyance (feeding to and removal from measuring device, rotation dividing, etc.)
- (d) Controls (by judgment signals, control of processing machines, and sorting of works)

3. Stages of Automation in the Measuring Process

An automatic measuring process generally goes through the following stages in the order given.

- (a) Automatic inspection

Measurements are taken automatically, and the results of the measurement are displayed (signals or buzzers) and recorded on other media.

- (b) Automatic rejection and separation

Based on automatic measurements, rejection and separation (OK + and OK -) are performed.

- (c) Automatic sorting

Based on automatic measurements, automatic sorting (separation into a majority class, + and -) is performed.

- (d) Automatic measurements are made while the work is being processed (in-process gauge).

By automatically measuring constantly changing sizes of a work being processed, necessary instructions (speed, position and change in direction) can be given to the processing machine.

- (e) Automatic measurements made using a feedback system (post process gauge)

Based on automatic measurement of the dimensions of a work immediately after its processing, necessary instructions (corrective actions) are given to the processing machine.

Of the above stages, (a) through (c) are classed under automatic sorting and (d) and (e) are considered automatic measurement. However, whatever forms they take, all of the stages are based on automatic measurement, none of them have independent on-line systems, and each of them exists in most

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cases as an attachment to or is linked to another machine. This trend is expected to continue in the future.

In summing up, there are two concepts for ways to meet the demanded functions: One is the automatic sorting method in which finished works are further classified by their measured tolerances; and the other is the automatic measurement method in which the precision of the measuring apparatus is used to determine the precision of finished products since present precision measuring apparatuses can maintain high precision more economically than available processing machine.

4. The Future of the Automated Measurement and Inspection, and Automatic Sorting System as LCA

To meet the demands of high precision, high speed, and high productivity, the demand for automated and systematized production processes is expected to increase in the future. To achieve this, measurement devices and controls are required elements and consequently the demand for automated and systematized measurement is expected to increase. As this increases, the role of measurement and inspection on the production line and the method of performing them may change.

In other words, the development trend will show a gradual change in the measurement and inspection functions of processes on production lines as these functions come to be more and more absorbed by automatic machines, and they will be increasingly systematized so that only within-tolerance works are forwarded to the next process.

With this in mind, the automatic sorting system and the automatic measurement system mentioned previously are considered two of the best systems to meet this.

It has generally been considered that automatic sorting and measurement are technically difficult to achieve and incur high costs. Thanks to the rapid development of various kinds of measuring apparatuses and control machinery in recent years, however, obtaining the right kind of measuring or control machinery is no longer a problem, and consequently, has simplified the design and manufacture of automatic assembly machines. This includes both software and hardware, and feeding, conveying, and sorting of works. This trend is especially noticeable in automatic sorting systems.

That is, the stage has been reached where these systems that were once considered by small-and medium-sized businesses as too difficult to achieve technically and also too expensive, have come to be viewed as a target for LCA that is now within reach.

Of course the scope of LCA depends on its purpose, and the scope is determined by the person setting up the system. Development, however, has now reached the stage where con-

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sideration is given to "an LCA system reaching a medium-scale improvement" instead of "an LCA system not exceeding the scope of a small-scale improvement".

An assembly process generally involves a lot of insert-spindle-in-hole operations or similar operations. These operations involve accurate fitting and are difficult to perform even by human hands. Man performs such operations by taking advantage of his vision and the delicate senses of his fingers but even then he requires some skill. Insertion generally takes a good deal of time, and the amount of time required to perform a task varies depending on the persons involved.

Consequently, a method to increase the speed of aligning and inserting a spindle in a hole was developed by raising the processing accuracy of parts and thus lessening variation in dimensions among parts. This method requires high precision machinery.

Recently, a new method for highly accurate fitting has been studied. In this method the machine is given a sensing system and flexibility that closely mimics that of a human operator. This method is still in the experimental stage and is also expensive.

If the tolerance of parts is set to a value several times that actually required, processing will be completed faster, much less equipment will be needed, and no sub-quality parts will be produced. Or if a system is established in which finished parts are automatically judged and classified into pre-determined lots, and the classified parts are fitted with each other, the end result will be same as if the processing accuracy of parts had been increased. Herein lies the meaning of automatic sorting as a prerequisite to this selective combination system.

5. Feedback Control System and Feed Forward Control System

Automatic sizing devices, such as an in-process gauge that measures work being processed and controls the speed of cutting as the dimensions change, and a post-process gauge that is widely used in centerless grinders that measure work immediately after it is processed and controls, based on the results of the measurement, the processing of the next work to be processed, are all typical examples of feedback control.

Contrary to this, under feed-forward control, disturbances are detected in advance and the target for control is controlled so that the disturbance will not adversely affect output. For accommodation controls in machine tools, disturbances such as cutting resistance, vibration and temperature are measured and the cutting conditions are controlled so that the evaluation function produces the largest value. This is only one example.

If selective combination in an assembly process is to be the target for control, the entire process including the selection work constitutes a feed-forward control system. Here, the

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quantity that needs to be controlled is the clearance after assembly is complete, and to maintain it at a fixed level, a control – by checking the variation in the dimensions of works (disturbance) and classifying them accordingly, and to pair works of the same class – is added to the assembly process.

The automatic inspection machine, automatic rejection and separation machine, and automatic sorting machine are all part of the feed-forward system in that the information on quality obtained as a result of their operations, such as the recognition of works that meet the standards, is used in the subsequent processes. On the other hand, they may be considered as part of a feedback system if rejected items, for example, are sent back and evaluated to improve the preceeding process.

6. Automatic Sorting

The following is an outline of automatic sorting as LCA.

Automatic sorting machines are generally devices that repeat the following cyclical operations.

- (a) Feeding of objects to be measured (automatic supply)
- (b) Fixing into position an object to be measured (fixing into position at the measuring position)
- (c) Automatic measurement
- (d) Display or recording of the results of measurement
- (e) Removing an object after it's measured (automatic removal)
- (f) Automatic sorting and automatic making

Depending on which of these operations is used and which is automated, the extent of LCA is determined.

6-1. Automatic Feeding Device and Automatic Removal Device

Various methods are used depending on the characteristics of the work, such as shape, measurements, material, place of measuring, and method of measuring, but in any case, parts feeding and conveying devices in assembly machines work as references.

6-2. Automatic Measuring

Currently used automatic measuring machines for automatic sorting can be classified into a) mechanism type, b) air type, c) electrical type, and d) optical type but the most widely used are air micrometer (back pressure type), air-electric micrometer, and electric micrometer. Air micrometers with a contact have an accuracy of up to $0.5\mu\text{m}$ but the accuracy can be increased up to $0.2\mu\text{m}$ by using an electric micrometer of the differential transformer type.

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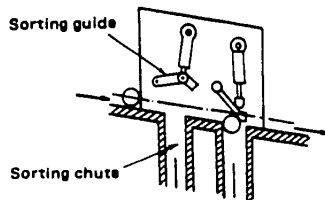


Fig. 1. Divider System

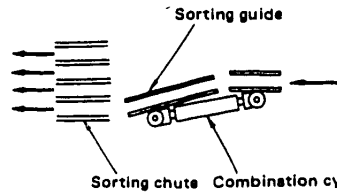


Fig. 2. Switch-over System

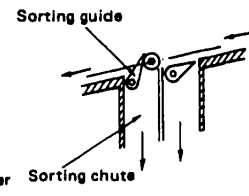


Fig. 3. Trap System.

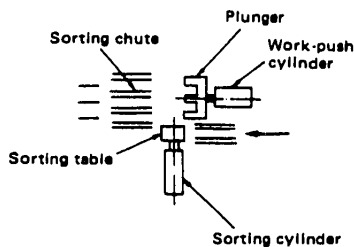


Fig. 4. Plunger System

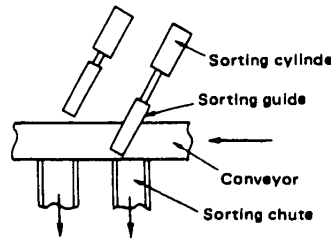
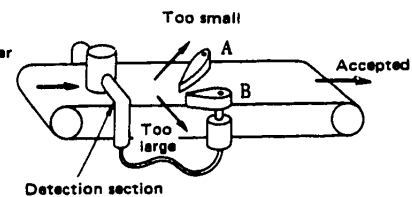


Fig. 5. Conveyor System

Fig. 6. Automatic Sorting System
That Drops Works to the
Right and Left

6-3. Automatic Sorting Method

When sorting works by measuring signals generated in automatic measuring, there are two types of automatic sorting: One involves only the sorting of works into an OK group and a NG group; the other proceeds as far as sorting of works and their fitting. There are the following methods of sorting.

(a) Divider method (see Fig.1)

With this system, works proceed through a sorting chute when the guide board is up. On receiving a sorting signal, the cylinder operates and lowers the guide board to drop the work into the designated chute.

(b) Switch-over method (see Fig.2)

In this sorting method, sorting is made by switching an electromagnetic valve by sorting signals and by shifting a sorting guide to a predetermined position by a combination of cylinder strokes.

(c) Trap method (see Fig.3)

This system is based on the same principle as the divider system in (a). On receiving a sorting signal, the sorting guide (trap) opens, and works are sorted into fixed sorting chutes. The sorting guide can be operated either by an electromagnetic valve or a direct solenoid.

(d) Plunger method (see Fig.4)

With this system, when a work is forwarded to a sorting table after it has been measured, the sorting cylinder operates after receiving a sorting signal, and the work is forwarded to a fixed chute. Next, the work-forwarding cylinder operates and the plunger proceeds forward and sorts the work into fixed sorting chutes. At this time, since the sorting cylinder must

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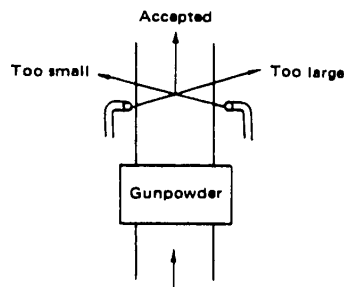


Fig. 7. Classifying System That Blows Works to the Right or Left

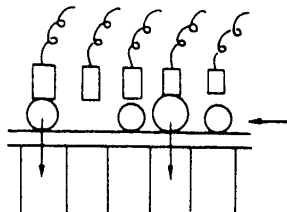


Fig. 8. System That Shoves Works off at Measuring Heads

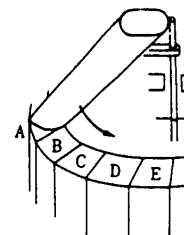


Fig. 9. Sorting System by Revolving Cylinder

always be aligned with the front of the fixed sorting chute when it stops, an oil pneumatic cylinder, or a combination cylinder for air pneumatic, is used.

(e) Conveyor system (see Fig.5)

With this system works are pushed down the slope of a sorting guide at the fixed position after a sorting signal is received, and works that are brought by a conveyor are sorted by the sorting guide.

In a similar way, a method is used in which sub-standard works are dropped to the left and right sides. For example, when works are too small, the sorting guide shifts to drop them to the left side. When works are too large, the sorting guide shifts to drop them to the right side, and all works that meet the standards proceed straight ahead on the central passage (see Fig.6). Again, in classifying products by weight into "accepted", "too light", and "too heavy" categories, one method used is to blow them into the proper bins by a blast of air. Inferior products are blown into either the left or right bin.

When the products weigh less than the standard weight, a blast of air blows them to the left side. When the products are above the standard weight, they are blown to the right (see Fig.7).

(f) A method of arranging more than one measuring element in a series (see Fig.8)

This system consists of measuring heads arranged in order of tallest to shortest, and works are shoved off from the side by either pneumatic or electric cylinder, for classification into categories. This system is highly reliable but also has the drawback of having numerous measuring elements requiring complex mechanism.

(g) Revolving cylinder system (see Fig.9)

This mechanism is simple and easy to operate, and this system can sort works into several classes with high reliability. On receiving a sorting signal, the rotating shaft causes the cylinder to change position and drop works into a storage box.

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The revolving cylinder can be rotated either continuously by changing the back pressure, or intermittently by using an electrical contact system.

(h) Labelling and stamping method

This system is used when works need not be classified into different sorting lines during the process. Sorting is made by marking with a punch or stamp. Sometimes colors or etching are used. This system comes in the following types.

- * Punch: Numbers, letters, shape
- * Ink stamp: Numbers, letters, shape, colors
- * Paint: Colors, shape

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SCIENCE AND TECHNOLOGY

AUTOMATIC INSPECTION USING MICROCOMPUTERS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 31-34

[Article by Oharu Suda, NEIS Co., Ltd.]

[Text]

At a meeting in 1970 of the CIKP (Conference of International Reproduction and Processing) held in London there evolved the "Integrated Manufacturing System" (IMS) (Fig.1), which was defined as a system with "needs" and "concepts" being inputs and with "inspected products" being output.

It is unnecessary to give further consideration to the meaning of "integrated". However, if this system can be divided into the upper stream, midstream and downstream along a flow, these divisions in general terms correspond to design, manufacture and inspection. Use of computers in the respective stages may be called Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) and Computer Aided Inspection (CAI).

The greatest change in production systems over the past 10 years has been the extended use of computers. Among them, CAI made a quick start. When IBM Inc. started sales of System-7, called the Sensor Base System, it was reported that its use would be mostly for inspection and test systems. It was considered that the remainder would be occupied by the monitoring of production lines and that there would be a very little demand for direct control of production lines (CAM in a narrow sense).

Since then, the passage of time has required the change of System-7 to Series/1. It may be said, however, that the chief use of computers in production lines is in inspection systems. The most significant in current computer use are the extra-large computers and micro-computers, which have been achieved through the technical progress of LSI (large scale integrated circuit). Although extra-large computers have nothing to do with production techniques, microcomputers have already well established themselves in factories.

The recent boom in personal computers, "micons", is stared in wonder. Magazines specializing in "micon" have been published one after another and "micon" shows are flourishing. Every visit to Akihabara, the electrical wholesale area in Tokyo, finds that another new "micon" shop has opened. "Invader Games", the computerized game machines which won great success as a kind of "micon" product, now seem to have become rather out of vogue. However development competition is severe to market

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a "post-invader" to follow on. Someone has called the situation "an outbreak of microcomputers". "Outbreak" is used here in the ecological sense, meaning that, as with insects, etc.,

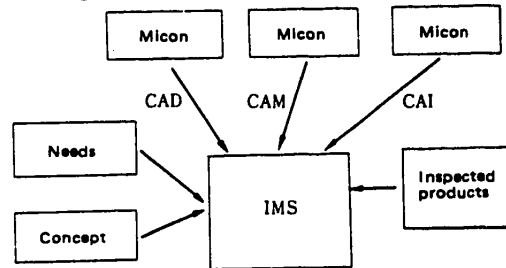


Fig. 1. Concept of IMS and Relationship Among CAD, CAM and CAI

microcomputers have suddenly begun to increase at an abnormal pace. Simultaneously, it seems that it is likely to suffer sudden extermination, and it has a slightly derogatory feeling. However, "outbreak" expresses increasing speed.

Incidentally, such a micon boom does not adapt itself to smell, like half-rotten cutting fluid in machine shops and is seemingly puzzled at the door. Let us review the reason why "micon" is not suited for use in machine shops, and let me introduce GPS-8 of this company, which is adapted for use in machine shops.

1. Microcomputers and "Micons"

Microcomputers and "micons" are deliberately used in a separate manner, in which "micons" indicate products priced at about ¥200,000 to be sold mainly for hobbyists. Three types are produced by TRS, APPLE and PET in the USA, while they are produced by Nippon Electric, Hitachi, Sharp, etc., in Japan. "Micon" is also a kind of computer consisting of an arithmetic and control unit, an internal memory, an extended external memory (cassette magnetic tape unit), a function part (keyboard) and a display unit (CRT display).

A large sized computer made 30 years ago was a machine of punched cards and a line printer, and a minicomputer 20 years ago was a machine of a teletype and paper tape, while a micro-computer made 10 years ago is characterized by a keyboard and a CRT display.

Applicable fields of computers are divided roughly into (1) office calculation, (2) technical calculation, (3) control, and

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(4) communication. However, most "micons" have, for constructional reasons, no interface that can be used for control or communication, and both the input of data and output of results cause bottlenecks in large volume office computation. As to the remaining technical calculation, function calculators for technical computation are far less expensive, more speedy, more accurate, and more handy.

Accordingly, the way computers are most generally used by hobbyists whose interests are in the pursuance of the computer itself, are to play on programs of games. Software is also sold chiefly for games.

2. Machine Shops and Microcomputers

Use of computers in machine shops is of course not directed to technical calculation or office computation, but concerns management and control of machines. Management and control are both included in control but what is closer to a machine is called control while what is a step away from it is called management. Control of machines includes (1) sequence control, (2) control of location, courses, speeds, etc., and (3) management of products and its feedback, etc. Management includes (1) production control such as inventory, rate of operation, and progress, (2) quality control, and (3) equipment control.

Quality control consists of an offline system for data processing with inspected goods being intervened and an online system connected directly with a line and synchronized with tact time. The online system is divided into an in-process system wherein data is measured during processing or assembly.

Table 1. Standard Substrate for GPS-8 CPU Card

CPU card	CPS-8 Standard card 280CPU Interruption 8 pieces, real time clock ROM 8k, RAM 2k
Extended RAM	RAM 16k
Serial interface	USART full duplex binary circuit 120BPS-19200BPS EIA RS232C or 20mA current loop
Input card	PHOTO ISOLATED 32 pieces
Output card	PHOTO ISOLATED 32 pieces
Analog input	4 multiplexer inputs, 12 bit digital signal
Analog output	12 bit DA converter binary circuit
Pulse input counter	Binary circuit 16 bit counter, with original pulse detection
Pulse motor phase control	Double one or two phase control, binary circuit
D.C. motor control	D-A conversion, voltage current conversion binary circuit

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ing, and into a post-process system wherein it is measured after processing or assembling.

For example, in the field of assembly, control of screwing torque is representative of in-process, and check of defective products is representative of post-process. In the field of metal-working, many in-processes are used for grinding machines and sensors of post-process are used for cutting tools such as fine boring.

For the application of micro-computers to these fields, interface and applicable software become decisive factors rather than the computer itself.

In a system like a desk calculator operated by electric cells and having only a keyboard and liquid crystal display, care must be taken only of static electricity acting as a noise from outside. When a computer is connected to machines, however, the cable providing the electric source, and input and output lines, all function like antennas and bring in noise from outside into the computer, causing unexpected functioning.

The difference between noise (N) and signal (S) is that S is what is predicted and expected, while N is what is unexpected. Although unexpected functioning caused by an unexpected input is called a "noise error", this statement is made without considering the standpoint of the computer. The computer might say that S and N are both the same electrical signal and cannot be discriminated unless a way for discrimination is programmed beforehand by man, and accordingly, that it should not be blamed for such an error.

When a micon, not just being used on a desk, is connected to a machine, it is placed in a very poor electrical environment because machines are all operated by electric motors, except the case where an air compressor is far away from a machine. Power voltage may be reduced by as much as 30% at the start of a neighboring heavy machine, and an input line may run in the same duct along with a welding cable of a large capacity.

As a recent example, specifications of a micon for machine control, made by a certain system house, describe nonchalantly that there should not be any source of electrical noise within 200m around. Computer makers do not know machines and machine makers have a prejudice against computers. Nevertheless, the tendency is to use micons. As a result, such an absurd system is produced. Not only the control board is solid state (transistorized) but also machines themselves become solid state and are covered with dust. Know-how as to how to use electronic devices in such circumstances should be developed from electronic instruments coming first to machine shops, such as NC equipment, measurement equipment, and sequence controllers.

Not only the electrical environment, but such conditions as temperature, atmosphere and vibration are severe to micons made for hobbyists. The first deadlock reached by engineers who intend to introduce microcomputers into machine shops riding on the micon boom, is environmental conditions, interface design and software design.

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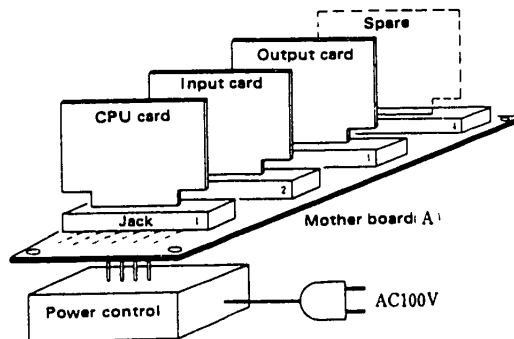


Fig. 2. Fundamental Construction of GPS-8

3. Required High-Level Language and Problem-Oriented Language

This company is an engineering group in steel, automobiles, etc., having much experience overcoming such deadlocks, and is dealing with larger-scale systems of computer-aided inspection and pattern recognition as a computer system house. It has developed a general use control system GPS-8 (General Purpose System-8) as a low end product. The main frame is the Z-80 of Zilog Inc., which is regarded as the best 8-bit micro-processor at present. Stress is put on sequence control and positioning control which are two major fields applicable in mechanical automation. It intends to provide interface and software to be instantly available (refer to Fig.2 and Table 1).

Micons oriented to hobbyists (the writer being one of them) have defects in that the language is fixed to BASIC, interface cannot be added or they do not withstand environmental conditions. At the next stage, what attracts one's attention is so-called SBC, which is sold as a board unit. It may be said that SBC of a board unit is sold entirely naked, as compared with micons which are well finished systems.

Accordingly, "support systems for development" or "house machines" are required for it to be programmed. Although micons are sold at ¥200,000 to ¥300,000, the house machine is priced at several million yen, which is a peripheral instrument not so different from the former. Furthermore, it does not permit high level language to be used as in micons, and it is required to master lower level (close to machines) language. Investment in the "house machine" unavoidably requires the same or more

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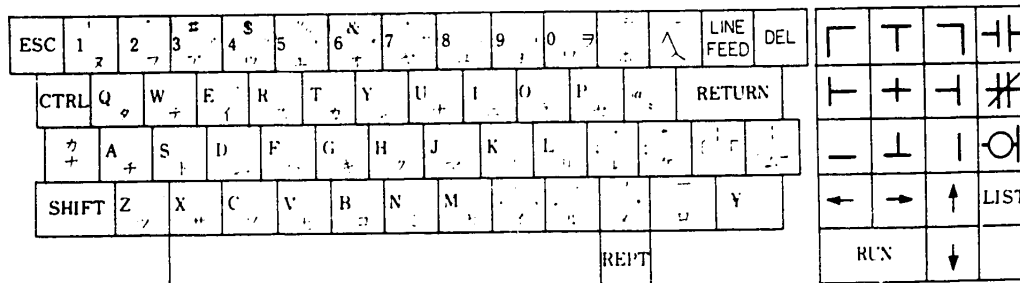


Fig. 3. Arrangement of Keyboard

amount to be invested in labor cost for engineers who take care of this machine.

Many persons are likely to consider that to master a language closer to machines means advanced utilization of micons. Slow execution speed of high level language inevitably leads to such misunderstanding. However, a computer is a mere tool and it is important that a simpler explanation will enable everybody to use it properly. Each person is not required to repeat the development history of computers.

In general, standards for appraisal of software are the following 5 items:

- (1) Satisfactory function
- (2) Short execution time
- (3) Small memory area required
- (4) Short program steps
- (5) Understandable

If they contradict, we are perplexed as to what should be taken. For example, when the same programs described at two places are prepared in the form of subroutines, items (3), (4) and (5) are satisfactory but item (2) becomes unacceptable.

Here, let us rewrite item (1) as follows: "Satisfactory function attained during the whole life of a system". No system has a fixed function. In the course of development, functions change kaleidoscopically. Required functions continue to change even after the completion of development. If it does not cope with this requirement, it will become a "system which satisfied the function tomorrow".

High class language and problem oriented language are by all means required by software which can cope with functions changing for the whole life of a system.

4. Language of GPS-8

Problem oriented language for sequence control of GPS-8 is a relay and ladder language called Cross-In-Sequence (CIS).

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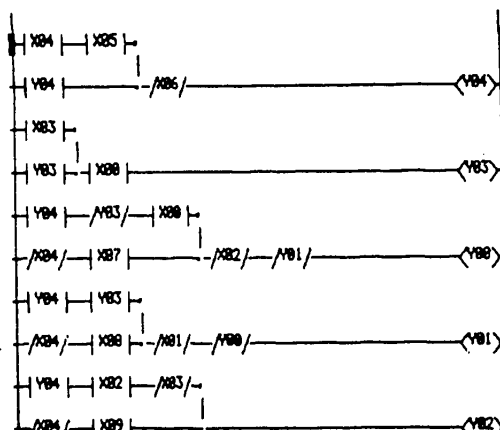


Fig. 4. Relay and Ladder Drawing (Video Plotter Output)

CPS-8 automatically depicts a relay and ladder figure of Fig.4 with an input from a keyboard shown in Fig.3, and at the same time automatically translates into mechanical words, so as to program with only the relay and ladder language.

A difference from general relays is that signals are made to flow only from the upper to the lower and from left to right, in order to avoid turning around.

This has already been realized in programmable logic control (PLC) dedicated to sequence control with the aid of hardware. However, the greatest characteristic of GPS-8 is that a combination of instruction words of Z-80 CPU allows a maximum of 256 input and output sequence controls to be dealt with simultaneously with the task, described with computer language, such as motor control and treatment of measurement data.

Sequence circuit on a picture plane is translated into the instruction of Z-80 each time one line disappears from the picture plane, and reversely a sequence circuit is formed from the instruction of Z-80 each time it appears on the picture plane. These processings are carried out not when a machine operates but when it communicates with a man so as to make a program — with sufficient time.

Standard substrate for GPS-8 has a 12-bit AD (analogue — digital) converter introducing to 4 multiplexers. Inspection of it into a spare slot shown in Fig.2 enables a sequence controller alone to serve also as a measurement unit. Discrimination of OK-NG also functions as input for sequence control or output for display.

Increase in slots enables measurement data to be recorded on cassette tapes and to be output on printers. If input and output are not so frequent and CPU time is sufficient, a simple statistical calculation can be performed. Of course, it is possible to connect on online to upper computers (with USART substrate).

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SCIENCE AND TECHNOLOGY

LARGE-SCALE INDIVIDUAL CREDIT INFORMATION SYSTEM BEGINS OPERATIONS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 73

[Text]

* The large-scale individual credit information system, into which the individual credit information center functions of each bank association in Tokyo, Osaka, and Nagoya are unified, started its operations in February 1981.

This system has accumulated in it data of so-called individual loans such as, housing loans, various consumer loans, current transactions, or credit card utility. Such a kind of system is deemed indispensable to the prohibition of credit accidents. Since the Tokyo Bank Association inaugurated the individual credit information center in 1973, 14 bank associations all over Japan have so far established the same

kind of center. However all centers except that in Tokyo employ the manual data check system with small quantities of collected data. On top of that, the information of each center could hardly be used mutually so they have suffered the problem that a black-listed consumer who had some accident in Tokyo could easily get credit in another district such as Osaka or Nagoya. The newly developed system is a wide-area on-line individual credit information system, introduced first in Japan and aiming at coping with such a problem and at the same time provide speedy credit checks and accurate operation by means of data intensification.

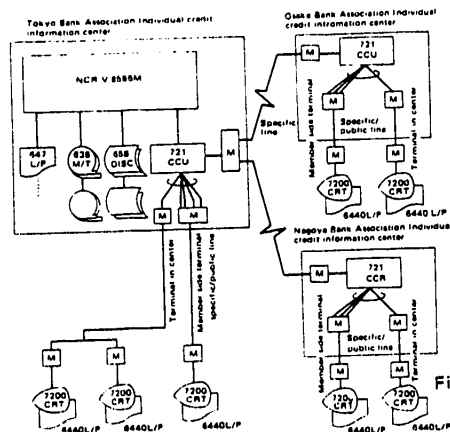


Fig. 1. General View of Individual Credit Information System

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SCIENCE AND TECHNOLOGY

LISP PROCESSING EXCLUSIVE COMPUTER EXPERIMENTAL MODEL MANUFACTURED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 75

[Text]

The Electrotechnical Laboratory has experimentally manufactured a high level language computer (LISP machine) which employs the PULCE (Pipe Universal Computing Element).

The LISP machine employs the general-purpose personal computer developed by the laboratory as a basis and has added to it the expanded functions fitted to the LISP processings. The system configuration consists of such units as the data operation-exclusive processor PULCE; the MMC, which controls the sequence of the microprograms' execution; the MIU, which executes the pointer operation or the stack processing; the control storage (MMC); and the I/O bus interface, which are all connected by the bus.

The features of the basic specifications are as follows:

- 1. The 16-bit general-purpose microprocessor, which has been developed in the big project, is used;*
- 2. Flexible hardware control is given by using the microprogram;*
- 3. The address space is wide (20-bit address capacity);*
- 4. The development of the exclusive unit (MIU) which efficiently processes the pointer operations, one of the functional features in the LISP language processing;*
- 5. The hardware version of access to the stack which raises the efficiency of the stack processing;*
- 6. Tags are provided to the setting of high-level compact macro instructions or to the data representation in order to decrease the burden on the software;*
- 7. File systems are created on the microcomputer provided with the floppy disk and connected by the high-speed line.*

As can be seen from these specifications, this machine attempts to improve efficiency by making the functions essential to the LISP language processing into the hardware at the same time as energetically turning them into the microprograms.

*The LISP-language processing format of the LISP-exclusive machine is such as that shown in Fig.2. In it, the program or the command input from the terminal by the user is interpreted and executed by the LISP firmware system and the result is output to that terminal, thereby providing the interactive processing in series. The format to be input by the user should be that of a function, e.g. *PLUS 5. 8. is input in order to calculate $5 + 8$. Also an arbitrary function required by the user can be newly defined, e.g. the function by the name of FACT can be defined by such inputs as shown in Fig.3. Another method is available whereby the function is defined beforehand on the file, converted into the intermediate language called the LAP code, and then the internal code version of the result given by the loader is interpreted and executed to perform the higher-efficiency processing. For example, the LAP codes produced when the above-mentioned FCT function is compiled are such as those given in Fig.4, in which each line corresponds to the intermediate machine-language instruction. The LISP system is provided with the controller which executes interpretations, distinguishing between the codes for the macro instruction and those for the user-input expression called the S expression.*

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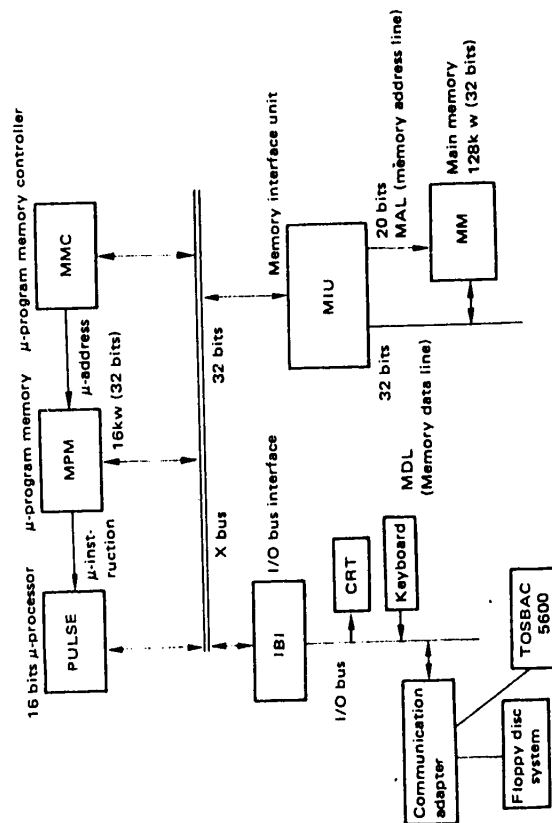


Fig. 1. Configuration of LISP Machine

```

(DE FACT (N)
(COND ((ZEROP N) 1)
(TIMES N (FACT (SUB1 N))))))

```

Fig. 3. LISP-Language Definition of Function to Obtain Factorial

```

G0001
(LAP FACT SUBR ((N) NIL))
(MOVE (ARG N) STACK)
(ZEROP IGNORE)
(BRANCH (NILFG NIL) G0001)
(MOVEC 1. RETURN)

(CALL FACT STACK)
(MOVE (ARG N) NEXT)
(MOVE (ARG N) STACK)
(SUB 1 LAST)
(TIMES RETURN)
NIL

```

Fig. 4. Output at Time of Compiling the Function by the Name of FACT

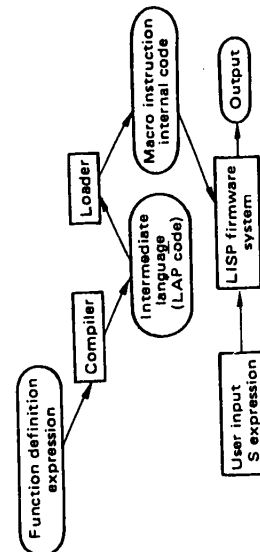


Fig. 2. Processing Flow

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SCIENCE AND TECHNOLOGY

ALL-TIME RECORD FOR PLASTICS MACHINE INDUSTRY

Tokyo BUSINESS JAPAN in English Vol 26, No 6, Jun 81 p 57

[Article by Katashi Aoki, president, Japan Plastics Machine Industry Association]

[Text]

JAPAN'S plastic manufacturing machine industry recorded an all-time high turnover in 1980, up 22% from the previous peak achieved in 1979, although the output of plastic materials and plastic products declined by 4% and 5.2%, respectively. This good record for plastics machines was a result of brisk demands from automakers, electronics manufacturers and other industrial users of plastic products. In line with the progress in their production streamlining program, an increasing number of manufacturers has started to manufacture plastic parts for their own use instead of seeking supplies only from outside sources. In 1980, injection molding machines ranked top on the list of plastics machinery installed for in-factory production of plastic parts by these users.

Active replacement demands from the plastic product processing industry also has contributed to the increased turnover of the machines in 1980. Plastic product makers found it necessary to install new machines offering a variety of technical improvements and innovations, all reflecting the many achievements in the field of plastic processing.

Major areas of technological improvements are outlined as follows:

Energy-Saving Molding

A large number of molding machines featuring a 40-60% cut in electricity consumption than their conventional counterparts have been put on the market.

Adoption of special screws and use of a barrel with specially-treated inner

wall are two of the typical methods employed in extruders to increase extruding power by which to reduce the amount of energy needed for operation. With injection molding machines, energy consumption is reduced through the use of a new mechanism designed to supply power only when it is required instead of providing a constant power supply as with the conventional type. A new type of polystyrene foam molding machine adopts separate molds, each devoted exclusively to the process of heating or cooling in order to eliminate loss of energy. (In the conventional type, the mold must be heated or cooled alternately to complete the operation.) Another example of energy-saving is a molding machine with a vent-equipped barrel. This eliminates the process of drying the material before it is fed to the machine.

Resources-Saving Molding

The manufacture of products which do not meet the standards not only wastes the material but also results in the useless consumption of energy. The plastics machine industry has completed a system to eliminate molding such products. Most of the systems developed for this purpose utilize a micro-computer which memorizes optimum operating conditions. With this system, the machine automatically adjusts to the most efficient operation, making corrections to accommodate, for example, environmental charges.

Super-Precision Molding

The super-precision process achiev-

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ed in injection molding has led to a rapid increase in demand for plastic products for precision engineering. Injection molding machines with this particular feature have been widely adopted by makers who had to rely previously on non-plastic products for their needs because 0.02-0.03mm was the maximum precision level for molded plastic. In most cases, some were made to a 0.01mm precision level, while others to 0.03mm. This lack of uniformity in measurements was another reason the manufacturers refrained from using plastic products. The latest molding machines not only boast a precision level as high as 0.001mm but also allow complete uniformity in measurements for all products manufactured through the use of a micro-computer.

Development of New Processing Technologies

The recent introduction of stretch-blow molding of PET, PVC, PC and PS materials has brought about a substantial change in packaging used for food, cosmetic and pharmaceutical products. In addition, the RIM system has been expanding its applications from automobile parts manufacturing to production of computer housings and many other areas within the electronics industry. The LIM system, too, is finding a wider range of applications. With the ever greater progress in plastic processing techniques now being built into processing machinery, plastic products are expected to fulfill an ever widening area of utilization. □

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SCIENCE AND TECHNOLOGY

BRISK DEMAND CONTINUES FOR PLASTIC PROCESSING MACHINES

Tokyo BUSINESS JAPAN in English Vol 26, No 6, Jun 81 pp 61,63,67-69

[Article by Atsushi Iida, secretary general, Japan Plastics Machine Industry Association]

[Text]

AFTER a continuing downward trend since 1973, Japan's production of machines for plastic processing turned upward in 1976 and reached a level which exceeded the previous peak record. The 1980 record was even better, breaking the ¥100,000 million for the first time in the history of plastics processing machine manufacturing in Japan.

As shown in Table 1, production in 1980 increased by 6.2% in quantity and 21.6% in value from the 1979 level. Percentage by types of machines against the total is shown as follows:

More than 90% of the 1980 production was occupied by injection molding machines and extruders. It is noted that the active demand for injection molders was the major reason for the overall growth of plastics machine production in 1980.

Types of Machines

Injection Molding Machines: Although exports remained almost on the same level as in 1979, a rapid increase in domestic requirements, particularly from automobile, electronics and precision machinery manufacturers, was attributable to the active performance of injection molder production in 1980. This was because makers in these specific sectors have begun to switch some of the plastic parts production to their own factories. Also supporting a marked increase in machine production was a growing

replacement demand for new machine models featuring innovative technologies for plastic processing. Machines specially designed for reducing the consumption of resources and energy, machines that assure molding to uniform measurements, high-cycle molding machines, totally automated processing machines and machines featuring automatic changes of materials, coloring and molds to increase operational efficiency are major types of injection molders newly introduced to the market during 1980.

Extruders: The 1980 turnover showed a slight decline in the number of units, but scored an increase of 17.5% in value from the 1979 level. Further sophistication in overall machine quality, which has pushed up the value per unit, explains the reason for the increase in value despite the quantitative decline. Just as with injection molding machines, a variety of new processing technologies have been incorporated into extruders — newly designed screws adopted to attain a substantial increase in extruding capacity, a temperature control system featuring accurate adjustment of incidental environmental changes to raise standards of product quality, and computerized control of molding operation are some of the examples of technical improvements.

It is also noted that an integrated system for blown film manufacture has been increasingly adopted. Here,

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Table 1. Japan's Production of Plastics Processing Machinery

(in ¥ million)

		1979	1980	1980/1979 (%)
Compression molding machines	Q'ty	84	75	89.3
	Value	498	1,140	228.9
Injection molding machines	Q'ty	7,669	8,391	109.4
	Value	67,812	82,700	122.0
Extruders	Q'ty	2,416	2,359	97.6
	Value	19,216	22,583	117.5
Blow molding machines	Q'ty	290	266	91.7
	Value	3,639	4,860	133.6
Calenders, vacuum or pressure forming machines, and foaming machines	Q'ty	274	309	112.8
	Value	3,856	4,267	110.7
Total	Q'ty	10,733	11,400	106.2
	Value	95,021	115,550	121.6

	1979	1980
Injection molding machines	71.4%	71.6%
Extruders	20.2%	19.5%
Blow molding machines	3.8%	4.2%
Calenders, vacuum or pressure forming machines, and foaming machines	4.1%	3.7%
Compression molding machines	0.5%	1.0%

everything from tubular film production and film printing through the final stage of making bags is processed on one integrated production line. With the introduction of this system, production capacity for PE and PP bags has expanded to a great extent.

Among other recent developments is a tubular film-making machine, now in the experimental stage, that uses LLDPE which is expected to become the mainstay in the field of PE materials. Many industries will benefit from the wide applications of this machine when it is finally commercialized.

Blow Molding Machines: The output in 1980 increased by 34% over the 1979 figure, but it represented an 8%

decline in quantity because large models occupied a greater part of the output.

One of the notable trends in 1980 was a wide range of industrial applications of extrusion blow molding machines whose utilization previously was dominated by the manufacture of bottles for cosmetics, detergents, pharmaceuticals and food. The new areas of application include molding of automobile ducts, and heat collectors and hot water tanks for solar systems. It is expected that the introduction of blow molding machines exclusively designed for super high polymer PE will rapidly increase demands for blow-molded products from many industrial sectors.

Stretch blow molding machines have been widely used for making bottles with PET. These bottles are increasingly adopted for use as cosmetic, detergent and food containers because of their transparency, toughness and gas-resistance capacity. Not only have they begun to take the share which used to be occupied by PVC and PE products, but they are also gaining wider markets through new

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Table 2. Production and Export of Plastics Processing Machinery by Type

(in number of units)

Year	Production		Export	
	Injection	Extruder	Injection	Extruder
1967	3,646	2,409	225	163
1968	4,325	2,890	347	198
1969	6,555	3,319	668	209
1970	6,583	4,740	747	272
1971	4,469	4,069	725	317
1972	7,158	2,310	898	239
1973	8,971	3,061	1,169	356
1974	3,979	2,645	961	360
1975	2,637	1,680	799	387
1976	6,068	1,700	1,415	318
1977	5,992	1,562	2,189	526
1978	6,409	2,156	2,391	492
1979	7,669	2,416	2,342	637
1980	8,391	2,359	2,361	439

ways of utilization.

Latest technical achievements in blow molding also include development of a stretch blow process using PC, PS, or PVC, although this process was previously considered the most difficult to accomplish. With this process, bottles of heat-resistant PS are manufactured at less cost, even though they are superior in transparency and shock-resistant capacity. A sizable demand for bottles of this type is expected from food manufacturers who utilize a high-temperature filling formula for their food packaging.

Vacuum or Pressure Forming Machines: Some of the vacuum/pressure-formed plastic containers for retailing food such as ice cream and margarine gave way to injection molded ones when improvements in injection molding technology made it possible to manufacture extra-thin containers. Today, new vacuum/pressure forming machines allow an integrated production, completing all stages of processes in one continuous operation — from sheet forming by extruders, vacuum/pressure forming and trimming, up to grinding the trimmed waste with which to re-feed the extruder. Now that such technological improvements have enabled mass-manufacturing by the vacuum/pressure forming process, containers made by this process have become competitive

with injection molded ones.

Compression Molding Machines: Full-scale automation is the latest development in the category of compression molding machines. A number of models on the market today are equipped with sophisticated automatic facilities for measuring materials, feeding them to the mold, forming them into the desired shape, and removing the products from the machine. Addition of such sophisticated features to the machine has pushed up the overall value of the 1980 output 2.3 times over the 1979 level, despite the approximately 10% decline noted in terms of quantity. In 1980, the turnover of transfer molding machines designed for IC and other precision electronics parts manufacturing showed a marked growth.

Exports

Exports of injection molding machines have remained almost on the same level since 1977 as shown in Table 2. Shipments in 1980 totaled 2,361 units, representing a slight increase over the 1979 data, but failed to reach the level of the previous.

Performance in 1980 as indicated in Table 3 was characterized by declining shipments to two major markets, South Korea and Thailand, but the decline was nearly offset by growing

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Table 3. Exports

		(in number of units)			
Country	Type	Injection		Extruder	
	Year	1979	1980	1979	1980
Republic of Korea		258	124	73	15
Taiwan		244	252	51	47
Hong Kong		458	527	15	34
Thailand		150	105	31	11
Singapore		339	264	83	47
Malaysia		78	67	14	32
Philippines		154	83	124	44
Indonesia		46	202	30	16
Iran		0	2	68	3
Iraq		13	4	8	8
United Kingdom		52	56	5	2
Italy		0	3	3	0
Canada		39	19	0	2
United States		323	357	25	14
South Africa		55	108	0	3
Australia		18	43	7	6
New Zealand		35	19	1	4
Others		80	126	99	151
Total		2,342	2,361	637	439

exports to Indonesia, South Africa and Australia. Although the U.S. has continued to be the largest market for Japan's injection molding machines in terms of value, an overwhelming quantity has been shipped to countries in Southeast Asia where molding machines made in Hong Kong and Taiwan have been expanding their share of the market. Because of strong sales offensives launched by these two countries, Japanese manufacturers have found it hard even to maintain previously established markets.

To cope with changing conditions, Japanese injection molding machine manufacturers are trying for the African market, as well as placing hopes on the U.K. and Scandinavian markets.

Table 3 shows exports of extruders which sharply dropped from 637 units in 1979 to 439 units in 1980. Shipments to Iran experienced the heaviest decline from the 1979 record of 68 units to only 3 units in 1980 due to the Iranian political situation. Also marking a drastic decrease were exports to South Korea which suffered from a foreign exchange shortage. Singapore, the Philippines and Indonesia were other areas to which Japan shipped fewer machines in 1980 than in

Table 4. Imports

(in number of units)

Injection			
Country	Year	1979	1980
United Kingdom		2	4
France		9	20
Federal Republic of Germany		189	203
Canada		39	8
United States		21	12
Others		16	51
Total		276	298

Extruder			
Country	Year	1979	1980
Taiwan		3	3
Sweden		0	6
United Kingdom		16	4
Federal Republic of Germany		15	21
Switzerland		13	7
Italy		0	2
Austria		3	2
United States		9	30
Others		0	0
Total		59	75

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1979. In these markets, Japanese extruders showed a rather poor sales performance because of the price increases due to the rising cost of production materials. Slowing sales of Japanese machines were also attributable to the tough competition from Hong Kong and Taiwan machines, among which many were blown-film extruders.

Imports

A slight increase was noted in Japan's imports of injection molding machines in 1980 as compared with the 1979 data.

As seen in Table 4, West Germany continued to occupy the position of the major supplier of injection molding machines to Japan, while France achieved a sharp increase in shipments of this type. Canada, which had been

mainly supplying high-speed injection molders for light-weight containers, recorded a sharp drop. It seems sales of machines of this specific type in Japan have already run their course.

In the category of extruders, shipments from West Germany leveled off, while a sizable decrease was noted in imports from the U.K., in sharp contrast to an exceptional increase in machines shipped from the U.S.

Imports of plastics processing machines, whether they are injection molders or extruders, have been enjoying a steady growth for the last several years. The imported models are limited to those designed for a specific type of molding which are not being mass-produced in Japan. The demand is not large enough to manufacture such models locally. □

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SCIENCE AND TECHNOLOGY

BIOMASS AS AN ENERGY SOURCE

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 35-45

[Text]

1. Introduction

The trend towards utilizing biomass as an energy source and for chemical raw materials has been prompted by the uncertain prospects for oil supply as well as rising oil prices.

Oil is pumped up from underground. Coal is also dug out from the ground. Since both of these are subterranean resources, they have characteristics common to all such resources; that is, their reserves are limited and unevenly distributed. This caused a serious problem of the supply of energy and chemical raw materials. (Table 1) (Fig.1) The supply capability of fossil resources is shown in Fig.2. In about the year 2000, production will hit its peak and decline thereafter. Even coal, where reserves are very large, will also become a problem, due to a

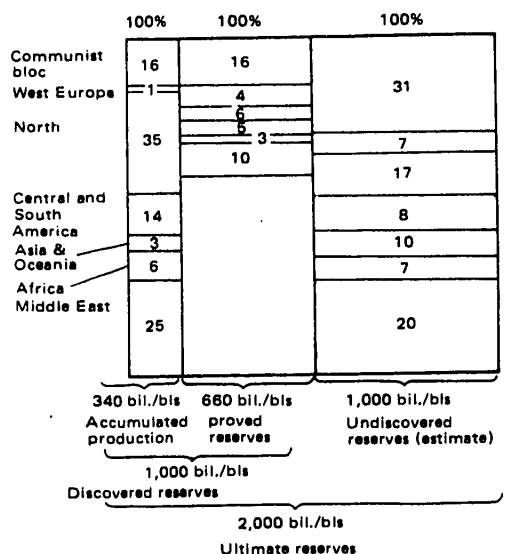
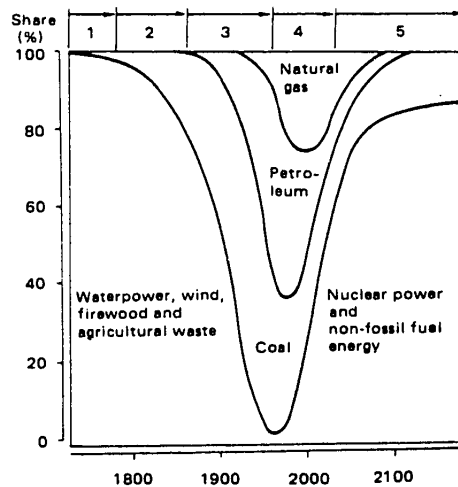


Fig. 1. Distribution of Petroleum in the World

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shortage in supply around 2300. Countermeasures against the exhaustion of fossil fuels are thus expected to be urgently prepared.

As suggested by the fact that petroleum and coal are called fossil fuels, they are made from the fossilized remains of biological entities. By this fact, they differ greatly from other subterranean resources. Since biological entities are direct or indirect products of photosynthesis, which makes use of solar energy, it also means that the fossilized remains of biological entities have been transformed by solar energy. On the other hand, the total solar energy which impinges yearly on the earth is very large, 1/72 of which is estimated to be equal to the total of all the oil and coal deposits, and 1/10,000 of which is estimated to be equal to the present annual consumption of



Source: Bohn, T. & Rath-Nagel, St. "Erdoel und Kohle" 1976, 26, 347

Fig. 2. Long-Term Change in the Utilization of Fossil Fuel Resources & Energy

energy by mankind. (Table 2).

Thus it is thought that we should utilize solar energy directly or indirectly instead of transformed solar energy as in the past, i.e., oil and coal. If technology is developed for efficiently utilizing even a small portion of the earth's solar energy as a new energy source, we will no longer have to worry about the supply of energy.

Needless to say, our technology is, as yet, by no means advanced enough to supply our energy needs from a solar source. Utilization of solar energy is categorized as follows:

- 1) Use of solar heat energy
- 2) Photovoltaic conversion, and
- 3) Biomass.

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Table 1. World Reserve of Energy Resource

	Petroleum	Natural gas	Coal (rich coal)	Oil sand Oil shale	Uranium
Ultimate reserves	2000 bil./bbls Free world 1,500 Communist 500	142,000 ~ 170,000 bil.m ³	7,700 bil.t	Oil sand 1,600 bil/bbls Oil shale 5,500 bil/bbls	—
Proved reserves	641.6 bil/bbls (1979) Free world 551.6 Communist 90.0	73,000 bil/m ³ (1979) Free world 46,000 Communist 27,000	490 bil. t Free world 290 Communist 200	—	2.59 mil.t (1979)
North America	5.2%	10.9%	24.9%	74.0%	36.4%
Central and South America	8.8	5.6	0.8	21.1	4.2
Europe	3.7	5.3	14.5	} 4.9	17.3
Middle East	56.4	28.8	—		(Others)0.2
Asia, Oceania	3.0	5.0	11.2		12.0
Africa	8.9	8.2	6.9		29.9
Communist bloc	14.0	36.3	41.7		—
Annual production	22.9 bil/bbls (1979) Free world 177 Communist 52	1,619.6 bil. m ³ (1979) Free world 10,648 Communist 5,548	2.61 bil.t (1978) Free world 12.0 Communist 14.1	Negligible	33,900t (1978)
Reserves production (year)	World 28 Free world 31	World 45 Free world 43	World 188 Free world 242	Long term	76
In term of petroleum (100 mil.t)	880	715	3,430	—	—

Source: Oil & Gas Journal, International Coal Trade
OECD/IAEA (Dec. 1974)

Table 2. Comparison of Energies with Solar Energy (In cal/year)

Total solar energy coming to earth	7.2×10^{23}
Estimated deposits of oil and coal	1.0×10^{22}
Worldwide yearly energy consumption	7.2×10^{19}
Acquisition of solar energy by photosynthesis	7.2×10^{20}
Yearly food consumption	3.6×10^{18}

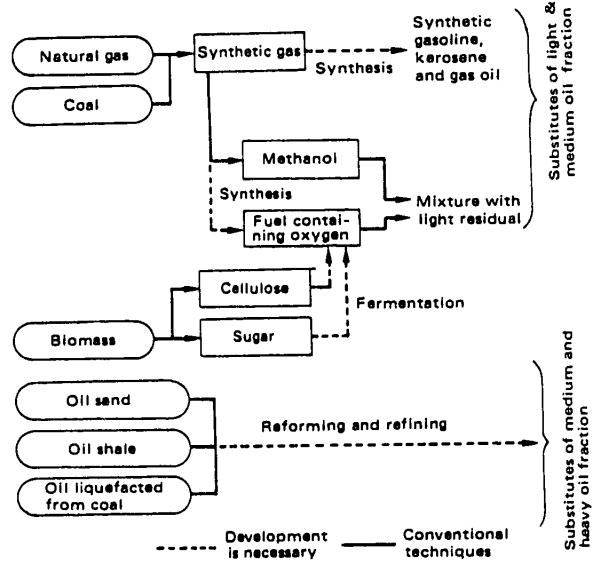
Source: Institute of Physical and Chemical Research,
"Solar Energy" (1978)

Among these, the utilization of biomass plays a very important role. This is because the annual absorption of solar energy by photosynthesis is ten times the annual world energy consumption in volume, while only 1/200 part of all photosynthesis is used as food. There is theoretically a good probability of utilizing biomass as an energy source. At this moment, the use of biomass is not regarded as economically feasible but research into its development continues.

In Japan, biomass is classified under the category of new fuel oil production (Fig.3,4), and the supply of new fuel oil is limited in the government plan of energy supply for 1990. (Table 3)

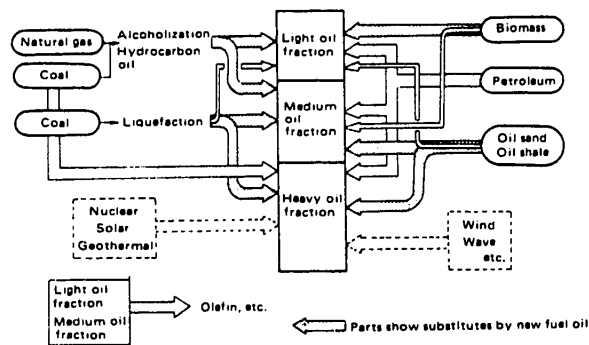
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Source: Agency of Natural Resources and Energy, "New Fuel Oil" (1980)

Fig. 3. New Fuel Oil Supply System



Source: Agency of Natural Resources and Energy, "New Fuel Oil" (1980).

Fig. 4. Conceptual Diagram of Utilization of New Fuel Oil

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Table 3. Long-term Energy Supply-and-Demand Prospects

	FY 1975 (actual)		FY 1985				FY 1990	
	If present policy cont'd		If measures stepped up		If measures stepped up		If measures stepped up	
Projected demand								
Demand before saving								
Energy conservation rate								
Demand after saving								
Projected supply (by type of energy)								
Hydraulic power	General: 7.1 x 10 ⁶ kw Pumped	(5.7)	19.5 x 10 ⁶ kw 19.5 x 10 ⁶ kw	(3.3)	22.5 x 10 ⁶ kw 18.5 x 10 ⁶ kw	(3.9)	~26.5 x 10 ⁶ kw ~24.5 x 10 ⁶ kw	(3.9) (0.7)
Geothermal power	0.05 x 10 ⁶ kw	(0.0)	0.5 x 10 ⁶ kw	(0.1)	1.0 x 10 ⁶ kw	(0.3)	~3.0 x 10 ⁶ kw	(0.7)
Domestic oil & natural gas	3.5 x 10 ⁶ ki	(0.9)	8.0 x 10 ⁶ ki	(1.2)	11.0 x 10 ⁶ ki	(1.7)	~14.0 x 10 ⁶ ki	(1.7)
Domestic coal	18.6 x 10 ⁶ t	(3.4)	20.0 x 10 ⁶ t	(2.0)	20.0 x 10 ⁶ t	(2.1)	~20.0 x 10 ⁶ t	(1.8)
Nuclear power	6.62 x 10 ⁶ kw	(1.7)	26.0 x 10 ⁶ kw	(5.4)	33.0 x 10 ⁶ kw	(7.4)	~60.0 x 10 ⁶ kw	(11.2)
LNG	5.06 x 10 ⁶ t	(1.8)	24.0 x 10 ⁶ t	(4.9)	30.0 x 10 ⁶ t	(6.4)	~44.0 x 10 ⁶ t	(7.7)
Imported coal (Fuel coal)	62.34 x 10 ⁶ t (10.5 x 10 ⁶ t)	(13.1)	93.0 x 10 ⁶ t (6 x 10 ⁶ t)	(10.7)	102 x 10 ⁶ t (16 x 10 ⁶ t)	(12.4)	144 x 10 ⁶ t (40 x 10 ⁶ t)	(14.1)
New sources	—		—		2.3 x 10 ⁶ ki	(0.4)	~13.0 x 10 ⁶ ki	(1.6)
Subtotal	104 x 10 ⁶ ki	(26.6)	195 x 10 ⁶ ki	(27.8)	228 x 10 ⁶ ki	(34.5)	~340 x 10 ⁶ ki	(42.9)
Imported petroleum (LPG)	286 x 10 ⁶ ki (5.85 x 10 ⁶ t)	(73.3)	505 x 10 ⁶ ki (14 x 10 ⁶ t)	(72.2)	432 x 10 ⁶ ki (20 x 10 ⁶ t)	(65.5)	~452 x 10 ⁶ ki (25 x 10 ⁶ t)	(57.1)

Source: Advisory Committee for Energy.

Notes: 1. In view of the prospects for global supply and demand for petroleum, it will probably be very difficult to secure the fiscal 1985 import amount of 505 million kiloliters, thus increasing the possibility of an energy supply shortage if the present policy is continued.

2. The imported petroleum requirement of 432 million kiloliters in the second fiscal 1985 column represents the minimum necessary amount on the assumption that energy conservation and development of alternative energies are carried out to their maximum possible extent.

3. If the present policy is maintained, the imported petroleum requirement will reach about 587 million kiloliters in fiscal 1990. It undoubtedly will be more difficult to secure this amount against the background of the increasingly tight petroleum supply-and-demand balance throughout the world. Therefore, if efforts to conserve energy and develop alternative energy sources should fail, the energy shortage will be far more serious than in fiscal 1985.

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However, recent developments in the technology for using biomass are encouraging. Indeed, there is now a greater change of utilizing biomass than ever before.

2. Advantage of Biomass

Biomass has the following 5 advantages over the other energy sources:

1. It is a renewable energy source.

Biomass is produced by plants fixing carbon dioxide from air while obtaining solar energy. Carbon dioxide exists in air at 0.03% and is continuously produced so long as life exists. On the other hand, photosynthesis is continuously carried out by making use of carbon dioxide and solar energy. Thus, carbon dioxide in air is kept at a consistent level. Biological entities are producing organic substances by fixing this free carbon dioxide. Biomass consists of one aspect of the circulation of carbon dioxide in air. Thus, it is produced endlessly and will not be exhausted.

2. It is enormous in quantity.

Worldwide demand for energy (mostly fossil fuel) in 1970 amounted to a level corresponding to 1/10,000 of the solar energy which reached the earth. On the assumption that food consumption is 2,000 cal per person per day, the total food consumption of mankind (4 billion people) amounts to about 1/20 of the demand for energy. On the other hand, the capacity of the earth for producing biomass corresponds to 10 times the total demand for energy. Thus, the total amount of biomass is enormous.

3. From the environmental point of view, it is a clean energy.

Biomass is a product made by life fixing carbon dioxide from air. In other words, biomass is produced by fixing carbon dioxide, a gas harmful to life, and discharging oxygen, which is necessary to life for respiration. When it is dissolved, it ultimately results in carbon dioxide and water, emitting nothing harmful. In the intermediate stages, it emits a small quantity of harmful substances and technically there are ways to remove them. The table shows a comparison between exhaust gases from vehicles with biomass-fuelled engines and with petroleum (gasoline or kerosene)-fuelled engines. If alcohol is used, measures have to be taken for NOx, HC and aldehyde. Compared with oil fuel, improvements are needed in respect of aldehyde but no measures are necessary for SOx.

4. It is a self-supporting fuel.

Where there is land, sunlight, warmth and water, biomass can be produced anywhere on earth. It is not unevenly distributed as are fossil fuels.

5. It is highly sortable.

As will be described later, biomass is stored primarily in the form of alcohol. Alcohol is a liquid fuel, easy to transport and easy to store. This greatly differs from gaseous and solid fuels.

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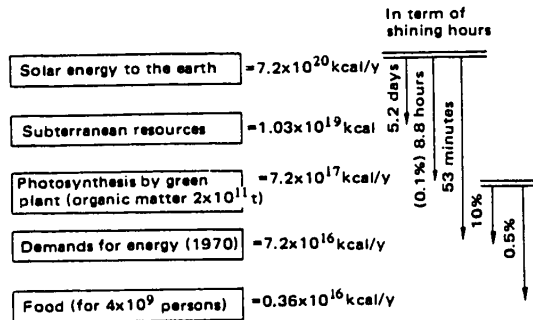


Fig. 5. Photosynthesis in the World Energy Demands

3. R&D Programs in Various Countries

3-1. Japan

In 1980, the Ministry of International Trade and Industry established a "Joint Research Group for New Fuel Oil Development" for implementation via a 7-year program. This group is composed of three subgroups: 1) a group for synthetic oil from synthetic gas, 2) a group for extraction of oil from oil sand or oil shale 3) a group for oil converted from biomass.

In the third sub-group, the major subject is the conversion of cellulose to alcohol which is highly important as a biomass resource, because it exists in very large amounts in unused resources which are also not needed as food. The Science and Technology Agency has launched several projects on biomass, which are joined this year by another project: "Comprehensive R&D of the utilization of biomass as an energy source". This new project includes methane fermentation, utilization of *Eucalyptus*, and conversion of hemicellulose and lignin. The Ministry of Agriculture, Forestry and Fisheries has also launched a new "Biomass Project" which included an assessment of living resources, introduction of new resources, recycling of resources, primary processing of raw materials, and conversion processes.

3-2. The United States

President Carter announced a "New Energy Policy" in July 1979 which aimed at decreasing the import of oil to 4,500,000 bbls a day (about half of that in 1979) by 1990, and to promote R&D on alternative fuels. The funds for all this amounted to \$140 billion raised by a petroleum industry surcharge. R&D on biomass has been carried out since 1975, through the "Federal

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Fuels from Biomass Program" which the Department of Energy, the Environment Protection Agency and the Department of Agriculture have promoted. Its budget in respect to alcohol is shown in Table 4.

On the other hand, a grass-roots movement in favor of using an alcohol-gasoline mixture (gasohol) has spread since 1978. In January 1978, a gas station in Springfield, Illinois began to sell gasohol (gasoline with 10% alcohol). By May 1979, 800 gas stations were reportedly selling gasohol.

3-3. Brazil

In 1975, the Brazilian government launched a national project "PRO ALCOHOL". In this project, the government made the use of gasohol compulsory, and provided various subsidies as incentives for companies to base their activities on biomass utilization.

In 1980/81 Brazil's estimated production of alcohol, through the government's measures, has increased to 2 million k/ from sugar cane, 1 million k/ from cassava, and 1 million k/ from bagasse. For this purpose, 3 million hectares of land are being used (=0.35% of total land area), 120ha of which have to be reclaimed, it is reported. Over the period 1977-1986, with these measures, Brazil is expected to save 3 billion in imports against an investments of \$600 million for reclamation and \$1100 million for the alcohol plants. Moreover, the whole program is expected to create more than 130,000 new jobs.

3-4. EC Countries

In 1975, the EC countries launched the first 4-year plan for solar energy utilization, which includes a biomass project. Each member country is studying some aspect of the project. For example, in Britain, the Energy Technology Support unit and its collaborators have carried out a feasibility study on organic waste, or green plants which are to be used as energy sources. The budget for the four-year plan was £12 million, 1.2 million of which was assigned for the biomass project.

In Sweden, the Energy Forestry Project is the important one. It includes R&D on the subjects of redesign of auto engines, and conversion of forestry resources into methanol. Sweden regards forestry biomass as its most valuable and abundant source of raw material supply in the longterm.

3-5. Canada

Canada is in the same position as Sweden. In addition to the conversion of timber resources to methanol, however, raw material for biomass in Canada includes agricultural and urban waste. It has a five-year plan which began in 1978 with a budget amounting to 380 million Canada dollars.

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3-6. New Zealand

New Zealand aims to produce ethanol from agricultural biomass, e.g. beets and corn, and from timber resources. It is also planning to produce methanol and synthetic oil from wood. In addition, there is an interesting plan to produce ethanol from Fodder beet which can produce 15kl of ethanol per ha.

3-7. Southeast Asia

Thailand, Philippines, Indonesia and Malaysia all have an interest in biomass utilization. Japan also has begun to cooperate with them.

4. Biomass Resources

Biomass resources include the following

- 1) agricultural products
- 2) agricultural waste
- 3) industrial waste
- 4) urban waste
- 5) stockbreeding waste
- 6) forestry resources
- 7) marine resources
- 8) microbe resources.

In addition, one method of acquiring solar energy making use of life, is producing hydrogen and oxygen by decomposing water by adding light or energy to microbes. At present, technology for utilizing microbes to produce hydrogen is at the stage of basic studies and is for the time being excluded from present discussions of practical energy.

4-1. Agricultural Products

Nearly all agricultural products can be foods in the form of biomass. Also, they can be turned into energy sources. They include rice, wheat, sweet potatoes, sugar cane, cassava, rapeseed, soy bean, sunflower, etc. If special seeds which grow in Iceland will be cultivated, they will be included in agricultural products.

Agricultural products will be one of the major resources for biomass. From this view point, effective products are needed. A measure by which a product is assessed is the yield per ha, and the conversion rate of it to alcohol. Table 5 shows the yield of agricultural products cultivated in Asia.

As production using an alcohol fermentation method is an

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Table 4. Federal Budget for Alcohol Fuel Development

(Unit million dollars)		
	1979 FY	1980 FY
Biomass	12.9	19.9
Ethanol	2.8	5.0
Production system (raw material for ethanol)	1.0	1.2
Cellulose decomposition	3.5	4.5
Gasification (methanol production)	3.6	7.0
Substitution of raw material	2.0	2.2
Development of alcohol fuel utilization	3.5	4.0
Methanol from coal	3.0	0.5
Basic research	0.1	0.5

Table 5. Yield of Agricultural Products and Alcohol from It

<Tropical>	Yield (t/ha. year)	Basic unit (t/kl ethanol)	Annual yield of Ethanol (kl)
Sugar cane	50 ~ 60	15.1	3.3 ~ 4
Cassava	10 ~ 25	5.3	1.9 ~ 4.7
Sweet potato	60 ~ 100 (3 time/year)	5.3	11.3 ~ 18.9
Sugar corn (Brazil)	Seed 5(15) (2 time/year)	3.0	1.7
	52.5*	15.2	3.5
<Temperate>			
Sweet potato (Southern Kyushu, Japan)	23.5	5.3	4.4
Fodder beet (New Zealand)	90	8	11 ~ 15
Beet (Hokkaido, Japan)	52	11.1	4.7

equipment-based industry, the capacity utilization rate is a big factor in production costs. Therefore, a continuous supply of raw materials is essential to keep costs down. In tropical areas it is possible to harvest throughout the year cassava and sweet potato, and besides this it is possible to dry-store them at the farm. This solves the problem of continuous supply. Though cassava and sugar cane are said to be the most promising products, cassava has some disadvantage due to its one crop per year. Sugar cane has two crops a year, but it has the disadvantage of not being able to be stored as dry matter.

At this moment, the sweet potato is considered to be the most promising raw material for the following reasons:

- 1) Yearly yield per unit area is largest because crops are 2-4 times per year.
- 2) Continuous supply is possible.
- 3) It is resilient against pests.
- 4) It does not begin to decay for 7 days, while cassava lasts only for 2 days.

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The cultivation techniques are most advanced in Japan and in the U.S.A., but especially Japan has a long experience of improving the yield of sweet potatoes. Mr. J.Kobayashi of the Kyushu Agricultural Experimentation Station is responsible for this matter. The average yield of sweet potato is 30t/ha a year, while an especially good crop can yield 50t/ha. Considering its good yield, the reasons why the sweet potato has not attracted wide attention as cassava are thought to be: (1) sweet potato is not suitable as a staple food due to its sweetness, (2) it cannot be cultivated by extensive farming techniques as is the case with cassava, (3) it is less resilient against severe drought and (4) it is less resistant to pests than cassava.

Recently the Philippines has developed a farming technique to prevent pests by flooding every 10 or 20 days. Development of agricultural technology may further change this situation on yield. Mr. L.A.Wilson's final target for improved yields is estimated as follows: sweet potato 200t/ha/y, cassava 140t/ha/y, rice 80t/ha/y and corn 50t/ha/y. However, Japanese specialists think annual yield should be over 400t/h for competing with gasoline when conventional conversion process is applied. Mr. Hayashida of the Okura & Co. reported there is a good prospect that the co-farming of cassava and sweet potato will yield more than 300t/ha/y in the very near future in Malaysia, providing enough fertilizers and good farming. In fact some Malaysian farmers are growing sweet potatoes between the rows of cassava for preventing weeds. They are cropping 200t/ha/y.

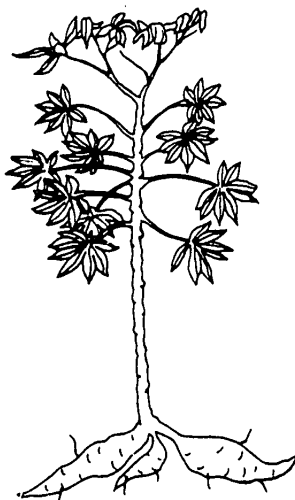


Fig. 6. Cassava

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Alternatively, new varieties of plants are being developed. For instance, Beetato Product Ltd. of Columbus in New England, U.S.A. has cultivated a new plant, the "Beetato", which is created by crossbreeding a beet and a potato. In the test period 1976-1979, this plant showed a yield of 180t/y/ha helped by irrigation.

These facts suggest that new cultivation techniques may create suitable new plants in the near future. Along with these plants, which are expected to be raw materials for ethanol, there are some plants which are expected to be raw materials for the chemical industry. The following are some of them which are not directly used for foodstuff or feedstuff.

Milkweed (*Asclepias Syrica*) was chosen by the U.S. agricultural department as a new resource for elastomer. It is expected to be easy to increase the productivity of milkweed over that of *Hevia brasiliensis*. Guayule which has a longer history of development than milkweed was widely cultivated during World War II. The Firestone Corp. has disclosed its tentative cost estimate for making rubber from guayule. According to the company, the cost could fall to US\$0.43 per pound by 1985 to make it competitive with natural rubber.

Euphorbia genera, which includes the well-known Euphorbia lathyris, is a promising hydrocarbon plant. According to Prof. M. Calvin, dry matter of Euphorbia lathyris contains 5% (in weight) of butane-soluble matter, which has a calories count of 17,800BTU/pound, and 30% of methanol-soluble matter with 7,300BTU/pound. Euphorbia tircalli which is attracting Japanese attention contains 9% oil (0.4% of benzene-soluble and 8.5% of acetone-soluble matter). By rough estimation, the cost of oil from E. tircalli is reportedly nearly the same as that of petroleum at \$40/61.

Leucaena leucocephala is a tropical root nodule plant which grows in symbiosis with nitrogen fixation bacteria. It can be used as a hydrocarbon plant, while it is also raw material for pulp.

Jobba (*Simmondsia californica*) is the focus of attention as an oil and fats plant. Its seeds contain about 50% gliceride oil in weight, whose major component is erucic acid. Crambe abyssinica also produces erucic acid. As is well known, erucic acid can be induced to nylon 1313 via brucine acid. Iron weed (*Veronia Authelmentica*) and Alchornea Cordifolia can produce epoxide fatty acid.

Note: Zeolite catalyst ZSM-5 06 Mobil Oil is known to be a catalyst which can convert methanol to gasoline. Mobil Oil announced recently that this catalyst also easily reconstitutes jobba oil, corn oil, etc. into hydrocarbon oil.

4.2. Agricultural Waste

Chaff, rice and wheat straw, and other remains of agricultural food products after edible portions are extracted, amounting to huge quantity, are wasted without being utilized. These are usable resources.

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4-3. Industrial Waste

When forestry resources are processed into lumber, large quantities of unusable branches, bark, etc. are wasted. When lumber is used industrially in woodworking, large quantities of chips, sawdust, shavings, etc. are produced. When factory drainage is biologically treated, sludge heavily containing microbes is produced. These are all usable as biomass resources.

4-4. Urban Waste

Some of urban waste also can be used as biomass resources.

4-5. Stock-Breeding Waste

In most cases, excrement of livestock is wasted, although it is used as fuel in some countries. This can also be used as a biomass resource.

The quantity of waste is very large. Table 6 shows the estimated unexploited waste biomass in Japan, which can supply enough alcohol to drive all the automobiles in Japan, if converted to alcohol.

4-6. Forestry Resources

Fallen or withered trees in forestry areas can be used as unexploited biomass. Some special plants of the pulse family such as ipil-ipil can be used as energy sources by cultivation. Note that ipil-ipil is used as quality charcoal.

4-7. Marine Resources

Giant kelp, for example, which is now experimentally cultivated in the sea, is considered to be a hopeful biomass resource, as its crop per unit area is large.

4-8. Microbe Resources

Production of microbes is a typical method of utilization. This kind of resource, however, is biomass as food and feed rather than an energy resource.

5. Types of Biomass Utilization

5-1. Supply System of Alcohol Fuel

Biomass is mostly found as solids composed of 1) starch 2) cellulose 3) hemicellulose, and 4) lignin, though sometimes it is found in the form of protein or fat. These are used as 1) an energy source 2) raw materials for the chemical industry, when food and feed stuffs are excluded.

In its utilization as an energy source, biomass is in some

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Table 6. Waste and Unexplor Biomass in Japan

Item	Quantity generated	Estimated organic (dry matter, 10,000t/y)
Unexploited wood	20,000,000m ³	(400kg/m ³) 8,000
Forestry waste	9,000,000m ³	(") 3,600
Lumbering waste	28,000,000m ³	(") 11,200
Used lumber	2~30,000,000m ³	
Agricultural waste	12,000,000t (Dry matter)	12,000
Urban waste	33,000,000t	(30%) 10,000
Livestock waste	62,780,000t	6,280
Paper industry waste	570,000t (Dry matter)	510
Industrial wastewater sludge	1,660,000t (Dry matter)	1,160
Food processing industry waste		220
Human waste	42,300,000m ³	1,200
Sewerage waste	59,100,000m ³ (99% Moisture)	(1%) 590
Total		54,760

Source: National Chemical Laboratory, "Tokoshi News" 13-6, 1978

Table 7. Composition of Wood & Rice Straw

	Cellulose	Hemicellulose	Lignin
Wood	50	20	25
Rice straw	40	33	6

utilize in the form of such solids if it is to be used as an alternative fuel to oil.

Thus, it is necessary to use biomass efficiently as fuel by changing it into liquid or gaseous fuels.

The supply system of alcohol fuel is shown Fig. 8.

Part of biomass is gasified to synthesize methanol, while a larger part is converted into ethanol.

5-2. Liquid Alcohol

As it is well known, starch, cellulose and hemicellulose are made of a collection of glucose. Lignin contains benzene nuclei.

The chemical structural formula of starch is relatively simple. It consists of a simple chain of glucose. Starch can be relatively easily decomposed by enzymes into glucose, which is converted to ethanol. This is carried out by the process shown in Fig.12.

Woody plants are largely composed of cellulose. Like starch, cellulose is also composed of glucose, but unlike starch, it has each link of its glucose chain reversed. Thus, enzymes which decompose starch are not able to decompose cellulose into glucose. In addition, cellulose is solid and hard. So, it has to

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be loosened before enzymes can be applied to it. In order to loosen it by present techniques, cellulose has to be pulverized or cooked in a weak alkali. This requires a great deal of energy and cost. Amylase which dissolves starch is not applicable but an enzyme called cellulase has to be used to break up cellulose. At this moment, the cellulose decomposition process which is best known is the Gulf Oil Co. SSF process (Simultaneous

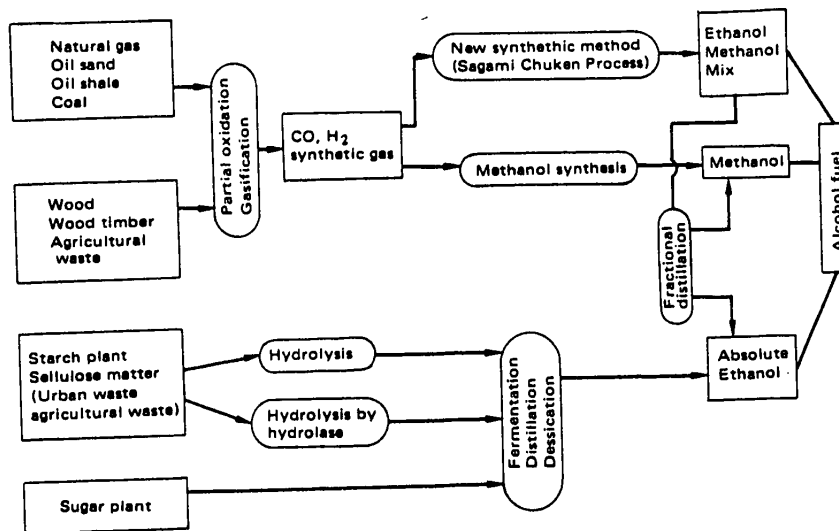


Fig. 8. Alcohol Fuel Supply System

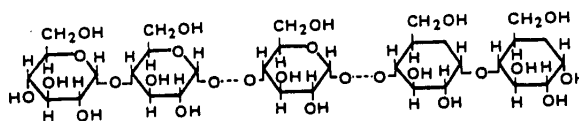


Fig. 9-1. Structure of Amylose

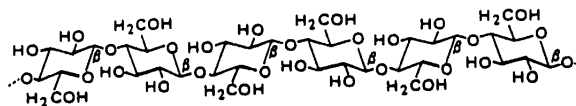
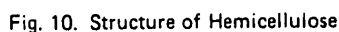


Fig. 9-2. Structure of Cellulose

Saccharification & Fermentation Process). Fig.13 shows its conceptual flow chart, and Fig.14 shows the plan of a pilot plant of the SSF process. This pilot plant has shown an operating capacity of 1t/day since 1976. It is characterized by the fact that it handles pre-treated cellulose with saccharification at the

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Woody resources heavily contain hemicellulose in addition to cellulose. They cannot be effectively utilized unless hemicellulose is utilized in addition to cellulose. Hemicellulose is composed of chains of a type of sugar different from glucose and these chains are hard to break. In order to sever them, an enzyme called hemicellulase has to be used. Although cellulase and hemicellulase are sufficiently popular enzymes to be commercially available, they do not have very high dissolving power and are not suitable enzymes for the purpose of decomposing cellulose and hemicellulose industrially. If it is desired to utilize cellulose and hemicellulose industrially, powerful enzymes have to be developed. Besides this, there is another process by which hemicellulose is decomposed into xylose. Of course it is possible to gain xylic, easily from xylose; however, there is another process of xylose \rightarrow xylulose \rightarrow ethanol. The latter process is called the SIF process (Simultaneous Isomerization & Fermentation), whose concept is shown in Fig.16. This process is hopeful for utilizing hemicellulose.

The conventional process is basically good enough for the gasification of biomass. Fig.17 shows the concept of the gasification process of biomass.

75.

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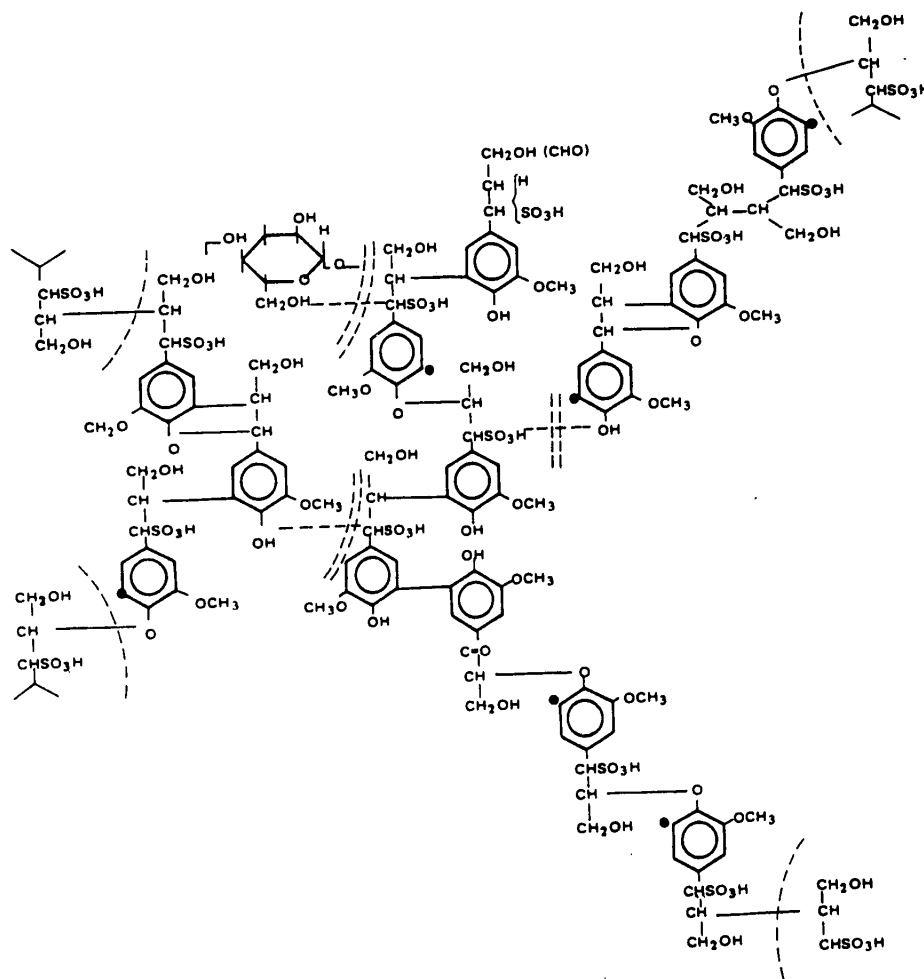


Fig. 11. Structure of a Lignin Sulfonic Acid

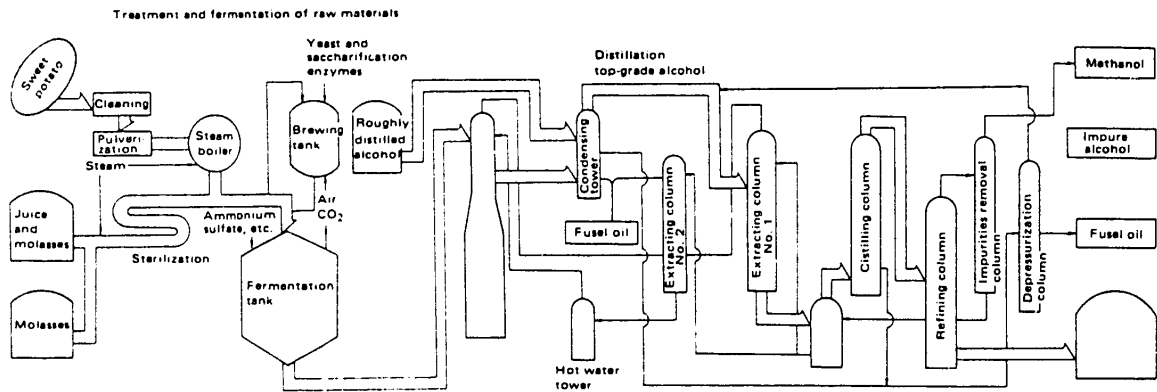
been developed. However, much development work is currently being undertaken. For example the Purex process of Union Carbide, the processes of Moore-Canada (Richmond), of Battle (Pacific Northwest Laboratories), of Pullman-Kelloy, of Alberta Industrial Development, of Dekab Ag Research, of Sagami Central Institute etc. are all included in this category.

5-4. Others

The remaining portions of woody plants consist largely of lignin. Compared even with hemicellulose, lignin has a very complicated structure and is still harder to be decomposed.

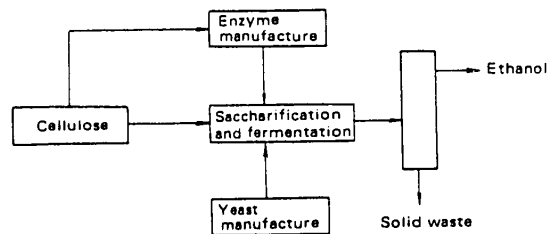
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Source: Data at Alcohol Industry Division of the Ministry of International Trade and Industry

Fig. 12. Current Alcohol Fermentation



Source: G. Emert, 2nd Chemical Congress of the North American Continent (1980)

Fig. 13. Conceptual Flowchart of SSF

When decomposed, it contains benzene nuclei. Thus, it can be utilized as benzene. However, studies on its decomposition have not yet produced sufficient results.

As outlined above, when the four components of biomass are decomposed into sugar, they can be utilized in the following forms: methane gas, alcohol, hydrogen and bacteria.

Of these, hydrogen can be obtained by the following process. A certain type of microbe is cultured in a sugar solution as a nutriment source, and the microbes are exposed to light to convert water into hydrogen and oxygen. Studies on this process are at an experimental stage and far from practical use

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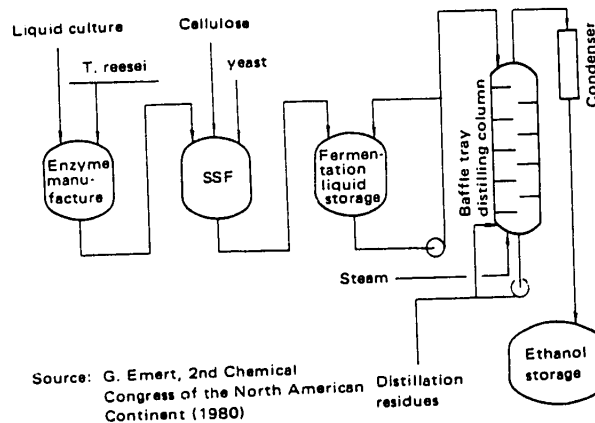
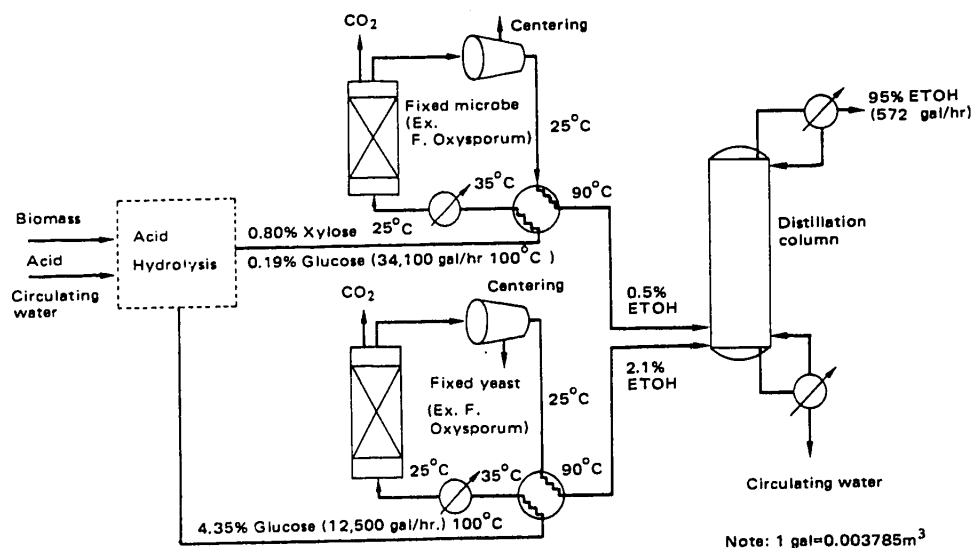


Fig. 14. SSF Process for Cellulose Biomass



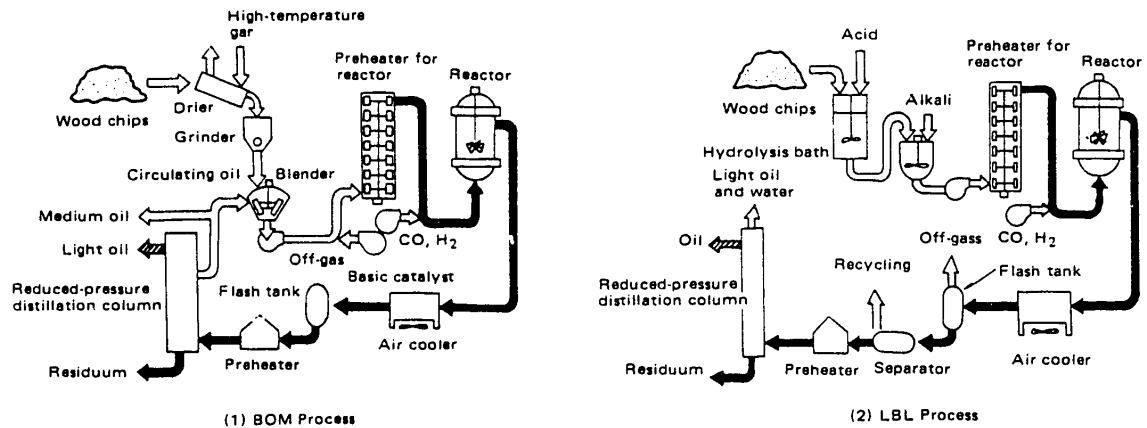
Source: O.C. Sitton et al.
CEP [12] 52 (1979)

Fig. 15. Conceptual Diagram of SIF Process

for the time being. For utilization as bacteria, microbes can be directly utilized as food and feed as a protein source because they are more than 50% composed of protein. The technology for this purpose has already been established. This leaves methane and alcohol as the forms in which further development is hopeful for utilizing biomass as an energy source. Of these two, methane can be obtained easily by fermentation. Furthermore, a membrane which is permeable only to methane has recently been developed, enabling methane to be easily

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Source: D.C. Elliott, 2nd Chemical Congress of the North American Continent (1980)

Fig. 16. BOM Process (Left) and LBL Process (Right)

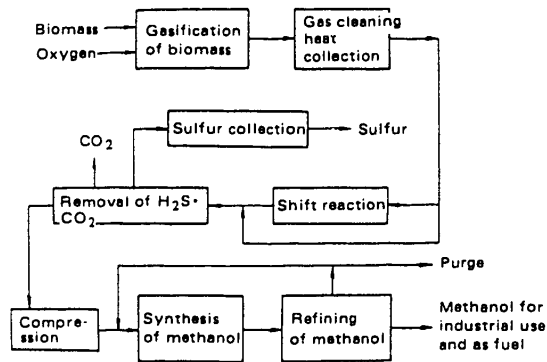


Fig. 17. Conceptual Chart of Biomass Gasification Processes - For Synthesis of Methanol -

obtained at nearly a 100% concentration. Since methane, even when unrefined and at around 50-60% concentration, has a calorific value of 5000 cal., it can be used satisfactorily as a fuel. However, the utilization of methane involves difficulties in two years. For one thing, methane is a gaseous fuel and is hard to store and transport. This is its main obstacle to large-scale utilization. In addition, although methane can be generated easily, it is technically very hard to obtain in large quantities continuously and stably. At present, therefore, it is recognized that the most practical way of utilizing biomass as an energy source is by changing starch, one of its components, into alcohol.

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SCIENCE AND TECHNOLOGY

REORGANIZATION OF CAUSTIC SODA INDUSTRY SUGGESTED

Tokyo BUSINESS JAPAN in English Vol 26, No 6, Jun 81 pp 75-82

[Article by Masaji Yamamoto, director, Basic Chemical Products Division, Basic Industries Bureau, Ministry of International Trade & Industry]

[Text] THE caustic soda industry is engaged in the production of caustic soda and chlorine through salt water electrolysis.

Caustic soda is used extensively in the manufacture of chemical fibers, paper and pulp, alumina and chemical seasonings, for dyeing and processing textiles, for the treatment of waste acids and for pollution prevention including the removal of NO_x and SO_x from exhaust gas.

Chlorine, obtained as a by-product of the caustic soda industry, is indispensable as a basic and auxiliary raw material for polyvinyl chloride, chlorinated solvents, polyurethane, other chemical products and chemical seasonings in the form of chlorine gas, hydrochloric acid and sodium hypochlorite. In addition, chlorine is used to purify city water and sewage.

The demand for caustic soda and chlorine has been stagnating in the protracted recession following the first oil crisis. The problem of surplus equipment has surfaced. Although demand picked up temporarily in 1979, it dropped again after 1980, reflecting a downward trend in general business.

A further decline in consumption seems inevitable now that the production of paper, pulp and PVC, which consumes the greatest quantities of caustic soda and chlorine, is slowing down.

Furthermore, there is a wide gap

between Japan and the United States in the production costs of ethylene, one of the basic materials of PVC. The import of ethylene in the form of ethylene dichloride (EDC), a semi-finished product, from abroad is on the increase, creating a problem for the caustic soda industry.

In the meantime, it was decided in 1973 to abolish gradually the mercury process in existing caustic soda plants so as to prevent environmental pollution. About two-thirds of all plant equipment was converted from the mercury process to the asbestos diaphragm process in the first-stage conversion program started in 1973 and costing about ¥230 billion. The conversion of the remaining one-third is progressing in the second-stage program at present, mainly to the ion exchange diaphragm process. The makers should endeavor to rationalize their managements in view of the huge costs needed for the change-over.

Demand and Supply

The output of caustic soda is slowing down following a peak in production reached in 1973. The operating ratio for equipment stayed at a low level of about 60% in 1976 when the conversion to the diaphragm process had progressed to a considerable extent, and have been operating at a low ratio ever since.

The domestic demand for caustic soda in 1979 stood at 3,085,000 tons,

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Table 1. Demand Trend of Caustic Soda

(Unit: 1,000 tons)

Year	Supply			Demand			Term-end inventory	Operating ratio
	Output	Imports	Total	Domestic demand	Exports	Total		
1973	3,214	66	-	3,196	98	3,294	71	82
1974	3,067	23	-	2,913	184	3,097	65	77
1975	3,007	-	-	2,791	125	2,916	156	69
1976	2,841	3	-	2,781	128	2,909	91	61
1977	2,882	28	-	2,842	62	2,904	97	62
1978	2,723	26	-	2,684	88	2,772	74	58
1979	3,213	26	-	3,085	134	3,219	95	70
1980 (est.)	3,034	37	-	2,900	195	3,095	71	64

Table 2. Breakdown of Demand for Caustic Soda

(Unit: 1,000 tons)

Item		1978	1979	1980 (est.)
Chemical fibers		234.4	244.7	228
Paper and pulp		319.2	360.2	346
Cellophane		39.4	45.1	35
Alumina		145.1	194.0	206
Dyeing		58.8	62.5	60
Chemical industries	Detergents	61.6	65.4	62
	Dyestuffs and intermediates	74.7	85.7	82
	Inorganic chemicals	583.7	584.7	538
	Electrolytic soda	69.0	77.7	73
	Organic chemicals and petrochemicals	117.9	130.6	118
	Others	548.7	708.0	720
	Total	1,455.6	1,653.1	1,593
Seasonings		80.8	87.5	79
Oil refinery		33.6	34.6	32
Others		317.3	396.8	321
Total		2,684.1	3,078.5	2,900

climbing 14.9% over a year earlier. This growth was ascribed to a brisk demand in the consuming industries — alumina, inorganic chemicals, paper and pulp, and chemical fibers — and to the preemptive demand in anticipation of soaring costs of raw materials and fuel, including the hike in electric power rates after April 1980. Exports with 134,000 tons recorded a substantial growth of 52.3% over a year earlier, thanks to the booming demand abroad.

As a result, the output of caustic soda in 1979 stood at 3,213,000 tons, up 18% over 1978 and approaching the peak year of 1973. Imports with 26,000 tons stayed on roughly the same level as in 1978.

The situation deteriorated in 1980. The deepening recession brought about declining demand in the chemical, chemical fiber and cellophane industries. The annual demand dropped to 2,900,000 tons, which represented a decrease of 6% from a year earlier.

However, exports in 1980 with 195,000 tons recorded a considerable gain of 45.5% over the preceding year, favored by the worldwide shortage of caustic soda and the formation of an Australian export cartel.

Imports in 1980 grew 42.3% to 37,000 tons, mainly due to the opening of the new Korean Dow plant. Imports, however, accounted for only 1.2% of overall supply.

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Table 3. Breakdown of Demand for Chlorine

(Unit: 1,000 tons)

Item	1978	1979	1980 (est.)
Paper and pulp	238.1	266.2	249
P V C	824.1	970.3	868
Seasonings	66.8	68.9	63
Chlorinated products	269.6	280.2	300
Chloromethane	90.4	118.1	122
P O	132.7	161.7	149
T D I & M D I	80.6	95.2	91
Dyestuffs and intermediates	86.7	103.7	111
Inorganic chemicals	270.7	301.9	287
Others	657.5	812.5	795
Total	2,717.2	3,178.7	3,035
Recovered chlorine	368.9	419.3	426
Balance	2,348.3	2,759.4	2,609
Caustic soda equivalent	2,724.6	3,209.6	3,034

Table 4. Imports of Chlorine Products

(Units: 1,000 tons, %)

Item		1977	1978	1979	1980 (est.)
EDC	Imports	54.1	288.0	344.9	185.2
	Import ratio	3.1	13.4	15.5	9.6
Carbon tetrachloride	Imports	5.7	12.4	21.9	30.0
	Import ratio	11.0	23.3	33.7	42.3
Perchloroethylene	Imports	1.4	5.1	15.3	10.0
	Import ratio	2.4	9.6	25.5	14.4
Trichloroethylene	Imports	0	0	0.1	0
	Import ratio	0	0	0.1	0
PO	Imports	0	2.4	2.4	0.1
	Import ratio	0	1.2	1.1	0.1
PPG	Imports	10.0	9.5	16.4	16.0
	Import ratio	6.7	5.5	8.8	9.1
PG	Imports	3.8	9.3	10.5	10.0
	Import ratio	8.7	20.2	19.2	23.8

The demand for chlorine in 1979 grew 17% to 3,179,000 tons (including recovered chlorine). The growth was accounted for by brisk demand in the PVC, paper and pulp, chlorinated solvents, inorganic chemicals and urethane industries as well as preemptive purchases in anticipation of future price increases.

The demand for chlorine dropped by 4.5% to 3,035,000 tons in 1980. Main factors causing this decline were the stagnation in the PVC industry which accounts for some 30% of the demand, and a slowdown in the pro-

duction of paper and pulp, PO (a raw material for urethane) and inorganic chemicals.

The international competitive power of chlorine made in Japan is being gradually undermined. Soaring prices of naphtha in Japan after the oil crisis have resulted in a sharp rise in olefin prices, whereas price rises in the United States and Canada are not so great. This has created a big price gap between Japan and these countries.

Moreover, rising electric power rates in our country are pushing up the manufacturing costs of chlorine prod-

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ucts and weakening Japan's competitive power.

As a result, imports of chlorine products are annually growing as shown in Table 4. Although the growth of imports slackened a little in 1980 owing to the domestic recession, imports of ethylene dichloride (EDC), the basic material for PVC, still stood at 200,000 tons and accounted for about 10% of domestic consumption. Imported carbon tetrachloride, basic material for freon, made up 40%, polypropylene glycol (PPG), basic material for urethane, made up 10% and perchlorethylene, used as a solvent and dry cleaning agent, made up 14% of the domestic demand. Thus the percentage of imported chlorine products in overall domestic consumption is rising gradually.

Future Responsibilities

There are several problems facing the industry. First is the demand and supply balance between caustic soda and chlorine, and the import problem of chlorine products.

Caustic soda and chlorine are produced simultaneously in the caustic soda industry, but it is difficult to maintain always the ideal consumption balance between caustic soda and chlorine because the fields of demand are different for these chemicals. This sometimes creates a difficult situation regarding chlorine, a gas of high toxicity that is difficult to handle.

In Japan the demand is always greater for chlorine. Surplus caustic soda has been exported. (Table 5) The imbalance of demand between chlorine and caustic soda is yearly growing.

As mentioned earlier, chlorine

products made in Japan are losing their international competitive power, and some chlorine products are being imported in increasing quantities. The industry is studying production and reimport of chlorine-related chemicals from countries where olefin is available at low cost or caustic soda is in demand. But an abrupt import increase in chlorine products could disturb the supply and demand situation in the domestic market, lower the operating ratio of plants and affect the production of caustic soda adversely.

Further rising of production costs for caustic soda and deterioration of Japan's international competitive power are conceivable if the operating ratio goes down and various fixed costs go up. In addition, there is the considerable gap in costs of electric power and raw salt in Japan and abroad. These conditions are certain to make Japan's position difficult in the seeable future.

Japan's caustic soda industry is carrying out a conversion program for its manufacturing process as explained below. Rationalization of the industry is essential for its survival and expansion. We must cut production costs whenever possible, ensure orderly imports of chlorine products, maintain the balance between overseas and domestic production and adjust the supply-demand balance between chlorine and caustic soda in a comprehensive way.

The second-stage conversion program for the manufacturing process is also a problem. The third "Conference for Promoting Countermeasures Against Pollution by Mercury, etc." (hereafter abbreviated to "confer-

Table 5. Demand-Supply Balance of Caustic Soda and Chlorine

Item	(Unit: 1,000 tons)			
	1977	1978	1979	1980 (est.)
Caustic soda (CS) domestic demand (A) (Imports thereof)	2,842 (28)	2,684 (25)	3,084 (26)	2,900 (37)
Chlorine demand (B) (Imports thereof)	2,955 (73)	3,020 (297)	3,593 (380)	3,302 (268)
Chlorine demand surplus (C) (= CS supply surplus)	68	64	155	171
CS exports (D)	62	88	134	195
Increment of CS inventory (C - D)	6	- 24	21	- 24
CS output	2,882	2,723	3,213	3,034
CS plants operating ratio	62%	58%	70%	64%

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Table 6. Caustic Soda Manufacturing Process Conversion Program

(Units: 1,000 tons/year, %)

Conversion starting	No. of enterprises	Scheduled conversion capacity	Conversion ratio
Jan. 1980 - Dec. 1982	7	448 ~ 508	27.3 ~ 28.6
Jan. 1983 - Dec. 1983	10	950 ~ 1,026	57.9 ~ 57.7
Jan. 1984 - Dec. 1984	7	243	14.8 ~ 13.7
Total	24	1,641 ~ 1,777	100.0

- (Note) 1. Some enterprises are entered twice in the list.
 2. Scheduled conversion capacity includes the mercury process equipment that can be dismantled or put out of action.
 3. The table includes enterprises with limited fund raising ability and management structure requiring improvements.

ence") resolved in November 1973 to convert caustic soda manufacture to processes causing less pollution of water systems.

The original plan called for conversion from the mercury process to the asbestos diaphragm process in two-thirds of the plants by September 1975, and in all remaining plants by the end of 1977.

However, the fourth conference held in May 1977 abandoned the original program on the grounds that caustic soda manufactured through the asbestos diaphragm process is of relatively low quality and cannot be used in some fields of application.

Consequently, the conversion of plants, which had not yet adopted the asbestos diaphragm process, was halted while the ion exchange diaphragm process, a newly developed manufacturing method, is being judged to see if its use is industrially feasible.

In the meantime, the Committee for Promoting the Conversion of Caustic Soda Manufacturing Processes in June 1979 judged that the ion exchange diaphragm process was industrially feasible and the fifth Conference in September 1979 resolved that the remaining soda plants should be converted to the new process by the end of 1984. The sixth conference announced the concrete conversion program as shown in Table 6.

The plants which have not yet carried out conversion (27 plants of 20 companies with an aggregate production capacity of 1,575,000 tons per year) are required to adopt the new process by the end of 1984. However,

harsh environmental and economic factors surrounding the caustic soda industry, including price fluctuations, the recession in interrelated industries, and the steep increase in the import of chlorine products might affect the pace of conversion.

Estimated investments of ¥130 billion are required to convert the remaining plants to the new process.

Tremendous efforts will be required of caustic soda enterprises, whose managements have been weakened by the first-stage conversion program and the subsequent recession, to carry out such huge investments for the second-stage conversion program. The structure of the industry itself will have to be overhauled.

On the other hand, the ion exchange diaphragm process has some advantageous features compared with previous processes, including smaller consumption of electric power and higher concentration of caustic soda with less residual salt content. It will benefit the industry in the long run, and should be promoted actively.

Conclusion

The caustic soda industry is suffering under ever-worsening conditions including soaring costs of raw materials and fuel, deteriorating profits and competitive power, and surging imports of chlorine products. Nevertheless, it must implement the conversion of equipment within the next three years.

The government on its part consulted the Industrial Structure Council in April 1981 concerning the organiza-

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tion of the petrochemical industries and the implementation of basic policies during the 1980s. In response, the Chemical Industry Committee of the council decided to organize a subcommittee for studying ways to strengthen the PVC and soda industries which are closely related to the petrochemical industries.

It would be desirable for the council to make a serious study of Japan's caustic soda industry and present a definite policy which would enable the consolidation of international competitive power and the smooth execution of the second-stage conversion program. This would assure that the caustic soda industry will play a vital role as a key chemical industry in the '80s.

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SCIENCE AND TECHNOLOGY

MANUAL ON FACTORY NOISE ASSESSMENT COMPILED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 49-51

[Text]

The establishment of noise assessment techniques is in demand as a means of noise pollution control. In response to this demand, the Ministry of International Trade and Industry has prescribed and compiled into a manual assessment techniques aimed at controlling factory noise. The following is summary of this manual.

1. Current Noise-Preventing Techniques and Assessment

The techniques of preventing factory noise have been generally established, except for special cases. Efforts are now being made to find techniques that are more economical.

From the economic point of view, it is best to plan and execute noise countermeasures at the time of factory construction. Countermeasures initiated after the onset of a problem are often under many restrictions and thus cannot be sufficiently effective. It is thus necessary to formulate correct countermeasures in an assessment conducted prior to construction of the industrial plant. An assessment does not merely serve to prevent noise but is, indeed, helpful for avoiding double investment.

Closely related to noise control techniques are measuring techniques and assessment. With respect to assessment in particular, in Japan the dB (A) scale is almost always used; it is used even for environmental standards and regulating standards, except for aircraft noise, and the present Japanese regulations do not incorporate the conception of noise duration, as at the assessed noise level proposed by the ISO (International Organization for Standardization). Though there are many instances where the use of assessed noise level is considered advisable from the realities of factory noise, the actual application of this level seems to have some problems.

2. Present Methods of Assessment, and Problems

The methods of assessment are not yet sufficiently established as a step toward noise control. In the case of air and

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water pollution, data and experience from more than 10 years of preliminary research are available for effective use but, in the case of noise, such experience is scarce and necessary data

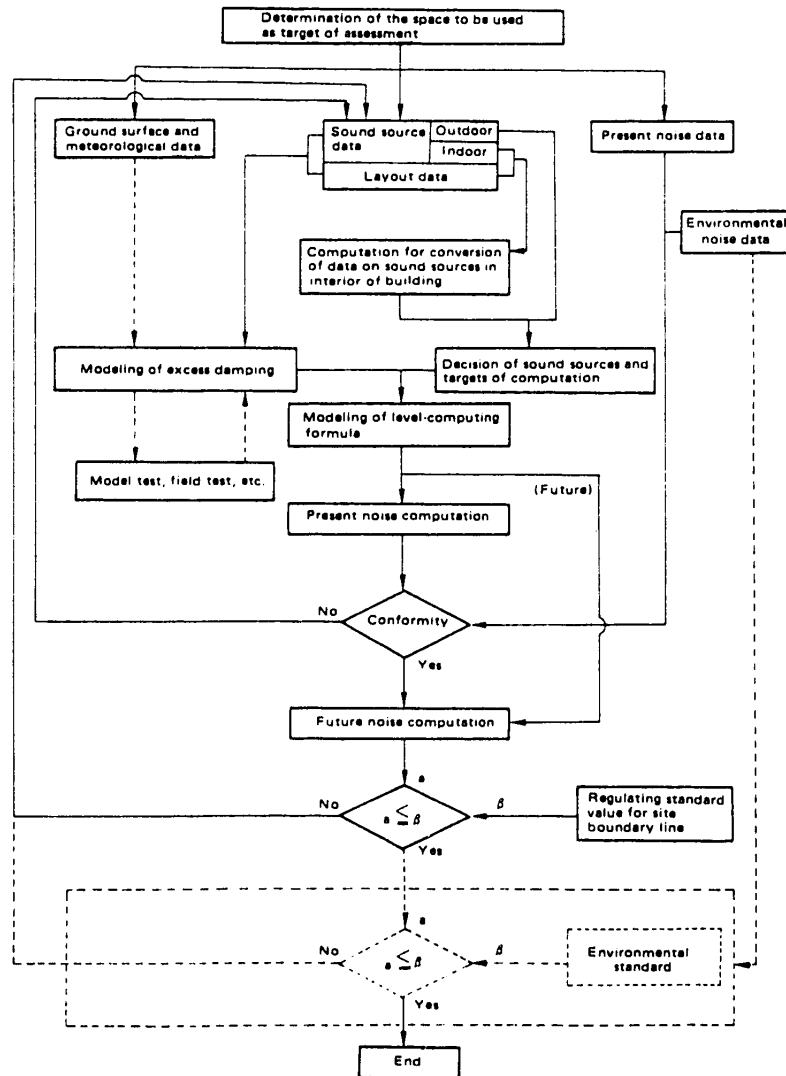


Fig. 1. Flow Chart of Noise Assessment

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must be provided hereafter through measurement and other activities in accordance with the purposes of assessment.

The first problem at the present stage is prediction of the noise power levels of noise sources. Related measuring methods have been set by the ISO, the JIS (Japanese Industrial Standards), etc. for some instruments, but these are all for small instruments, and measurement by large instruments is not, as a standardizing of measurement of noise-source power levels according to types of machines. This will create a major bottleneck in the conduct of assessment.

The second problem is the shortage of data concerning excess damping, which directly bears on the improvement of accuracy of assessment and the economy of control measures. whole, sufficiently accurate. Even in the case of small instruments of certain types, machines of the same type manufactured by the same company sometimes show different readings, depending on the conditions of operation and maintenance. This situation of the prediction of noise power levels, which is basic to assessment, poses a problem with respect to the accuracy of assessment. Further, the trend is toward future. Though there are some data on absorption damping by air and by the conditions of the ground surface, data must be acquired and accumulated in the future for excess damping, including that by air and ground surface.

Data on meteorological conditions are so inadequate that, for the present, prediction must be limited to standard meteorological conditions (windless and rainless weather).

As for methods of assessment, it is necessary to predict by computation and, if prediction by computation is difficult, to supplement with reduced-scale acoustic model testing or field measurement.

At the present technical level of model testing, testing for an entire factory is difficult and must be limited to only a small section of it. The limit to scale reduction is 1/40 to 1/50. Under special circumstances, model testing at reduced scales of 1/100 to 1/200 may be possible if measurements can be made at a representative frequency.

Since model testing involves these problems, there must be field measurement and field testing. It is important that field testing include the above-mentioned problem of excess damping.

3. Methods of Assessment

Assessment should be conducted according to the flow chart in Fig.1.

First, the space to be used as the target of noise assessment must be determined. It must not be limited to the site boundaries of the factory concerned, but should also include any adjoining residential areas that may be affected. Next, assessment is made in the case of expansion, and in the case of new construction, as follows:

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(1) Case of Expansion

a. Study of Conformity Under Present Conditions

First, a simulation model is prepared for the existing facilities, and the accuracy of the model is ascertained by data on the present conditions.

(i) Determination is made of the sound source to be the target of computation by collecting existing sound data and layout data.

(ii) A model is prepared for excess damping due to screens, ground surface and meteorological conditions. In this case, modeling for complex excess damping must be made by model testing, field testing, etc.

(iii) The formula for computing the overall noise level is modeled by means of the distance damping model corresponding to the above-mentioned computation target sound source and the excess damping model.

(iv) The present noise level is computed by this model and study is made of the conformity between the results of this computation and the results of analysis of the present noise level.

If the required accuracy cannot be obtained from this study, the modeling of sound source data, layout data and excess damping must be reconsidered, and work in (i)~(iv) repeated.

b. Predictive Computation

Future noise as of the time of expansion must be computed, using a model incorporating the change, etc. of sound source data and layout data for the expansion, after preparing this model from the model on present conditions.

(i) Sound sources forming the targets of computation are determined based on the sound source data and layout data for the existing facilities and the expansion.

(ii) In this case, a sound source in the interior of a building is substituted by a building sound source.

(iii) Those computation target sound sources which may involve excess damping must be modeled similarly to a-ii.

(iv) The level computing formula must be modeled similarly to a-(iii).

(v) Future-predicting computation must be conducted and study made as to whether the results of this computation are within limits of regulating standard values for the site boundaries. If the regulating standards are exceeded, the noise countermeasures must be reconsidered; thus, computation is made, using sound source data and layout data that have been newly prepared.

(vi) If necessary, future noise should be computed for the vicinity and study made of the conformity with environmental standard values.

(2) Case of New Construction

A procedure similar to "b" under "Case of Expansion" is used, but the existing plant, layout, etc. should be checked to confirm the accuracy of the model.

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SCIENCE AND TECHNOLOGY

HIGHLY EFFICIENT AUTOMATIC SCREW GAUGE METER

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 65

[Text] The National Research Laboratory of Metrology has experimentally manufactured an automatic screw gauge meter (On-Line Controlled Measuring Machine for Inspecting API Reference Master Gauges) which is capable of automatic measurement in 1/10 of the time needed by conventional large, 3-dimensional meters. The meter automatically measures the screw elements of API master taper screw gauges (such as the effective diameters, inner diameters, leads and tapers of external threads and internal threads) specified in the standards of the American Petroleum Institute (API).

The automatic screw gauge meter experimentally made consists of the components shown in Fig. 1. In contrast to the structure of large 3-dimensional meters, it uses a cylindrical coordinate system consisting of a diameter direction (R-system), a height direction (Z-system) and a rotational direction (Q-system), and also uses features of plain, ball and ball and roller bearings combined to increase measuring efficiency and measuring accuracy. Reportedly, this reduces the conventional measuring time, 10 hours required for a set of measurements made with a large 3-dimensional meter used in inspection, to 1/10, or 1 hour, while achieving higher accuracy.

The meter has the following main functions:

- (1) Measurable range--600mm in diameter direction (310mm in radial direction), 200mm in height direction and 360 degrees in rotational direction.
- (2) Diameter and height direction two-axial sensors-- $\pm 0.2\text{mm}$; measuring force: about 100g

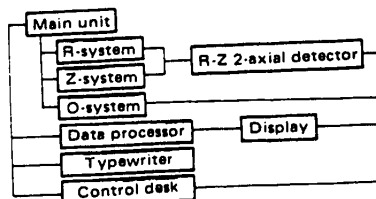


Fig. 1. Components of Measuring Machine

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SCIENCE AND TECHNOLOGY

MEASURING INSTRUMENTS RELATED TO LIGHT LASER

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 73

[Text] Ando Electric Co has developed four kinds (six models) of measuring instruments for light and laser, including an optical fiber analyzer.

1. The light power meter AQ-1111 is a compact, light-weight, general purpose power meter that measures the power of light and laser. It comprises a main body and a sensor. The sensor is a silicon photodiode for short wavelengths, or a germanium photodiode for long wavelengths. There are three display modes available: w, dBm, and dB. The measuring range of the power level is -70 to +10dBm/0.1nW to 10mW for the Si sensor, and -50 to +5dBm/10nW to 3mW for the Ge sensor.
2. The optical fiber analyzer AQ-1902 incorporates a function to detect the Fresnel reflection from the broken end of an optical fiber cable by the optical pulse method. The trouble can thus be located, regardless of the broken condition. Another function detects back-scattered light and measures both light and connection losses. The loss condition of the optical fiber cable can be displayed on a CRT, and the loss between any two desired locations, in addition to the total loss of the fiber, can be measured remotely from one end of the fiber.
3. The light wavelength type AQ1601 is a digital-display wavelength type light region consisting of two units, one for short wavelengths and the other for long wavelengths, with measuring wavelength regions of 0.78 to 0.9 μ m and 1.25 to 1.4 μ m, respectively. Accuracy is ± 0.5 nm.
4. The light spectrum analyzer AQ-1404 is a spectrum analyzer of the wavelength region to display the spectro-characteristics of laser diodes or light emitting diodes directly on a CRT by using a sweep spectroscopy according to wavelength selection. The wavelength range for the spectro-unit is 0.7 to 1.1 μ m for short wavelengths, and 1.1 to 1.6 μ m for long wavelengths.

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SCIENCE AND TECHNOLOGY

20 KW LASER MACHINING SYSTEM ADOPTED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 66

[Text] * The Agency of Industrial Science of Technology, MITI, has adopted a three-axis orthotropic system as the 20kW CO₂ gas laser machining system which was the most important development problem for their super-high performance laser applied Compound Production System.

Because of the 20kW CO₂ gas laser machining system is the nucleus of this large project, until now, two developments were set forward in parallel by Mitsubishi Electric Co. (three axis orthotropic system) and Toshiba Corp. (two axis orthotropic system). This big development project plans by March 1983, completion of an automatic production system for complex small batch production of machine parts which account for 70 percent of machine production. In the production system, the 20kW CO₂ gas laser machine is used for drilling, cutting, heat treating and so on.

At the first stage of research, two types of 5kW machines were developed: one Mitsubishi's three axis orthotropic system (direction of the laser beam, gas flow and discharge are perpendicular to each other); and the other Toshiba's two axis orthotropic system (direc-

tion of the laser beam and gas flow are perpendicular). The running performances of the two 5kW machines have been evaluated and examined, with the conclusion that Mitsubishi's three axis system machine is superior to Toshiba's.

Thus, in the second step, a 20kW machine with a three axis system will be developed. Consequently, Mitsubishi Electric Co. will be the main contractor and Toshiba will cooperate for the excitation portion. Both companies will complete the 20kW laser machine by September 1983.

The first largest laser machining system marketed in the world is that of Abuko Co. (U.S.A.) a 15kW machine but this machine was designed for laboratory use and has not yet been used in a production line. Behind the Abuko, the United Technology Research Co. is developing a 20kW machine in the U.S.A. It is expected that 5-20kW machines will form the main stream of laser machining in the near future.

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SCIENCE AND TECHNOLOGY

AUTOMATIC MEASURING CONTROL SYSTEM FOR LARGE MACHINE TOOLS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 67

[Text] Mitsubishi Heavy Industries has recently developed an automatic measuring control system for large machine tools.

If no large tables are available for measuring the machining accuracy of large parts machined by large machine tools, larger measuring jigs are required. However, jigs tend to introduce large measuring errors, caused by the difference in the posture of secured objects being machined, during cutting and during measuring.

The newly developed automatic measuring control system uses a numerical control unit, which is capable of micron-level control of the distance of movement, to automatically calculate machining accuracy from the movement of the machine and the movement of the measuring head. Thus, it has succeeded in preventing large measuring errors.

The system has the following features:

- (1) Mounted on a large machine, it can precisely measure diameter, pitch, the distance from reference surface, etc. of machined holes in large parts in the setup for machining.
- (2) It can be connected to 3 machines.
- (3) Its measuring heads are interchangeable with tools and can measure from 3-dimensional directions.

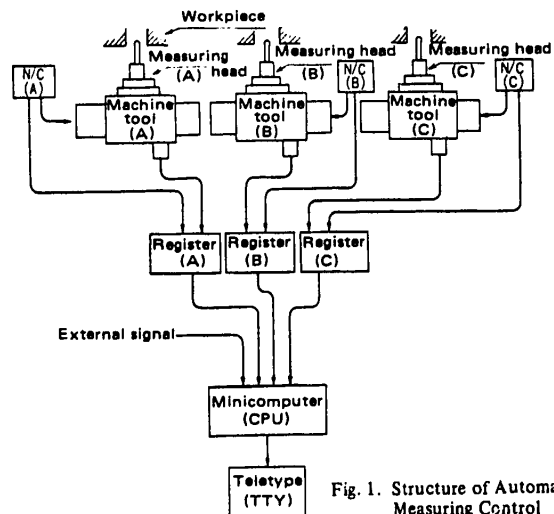


Fig. 1. Structure of Automatic Measuring Control

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SCIENCE AND TECHNOLOGY

NC ROBOT FOR APPLYING SEALING AGENTS

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 67

[Text] With the cooperation of Toshiba Silicon, Taiyo Tekko Co. has lately developed and begun marketing "Seal Maker," an NC robot for applying sealing agents, which is the first successful venture of its kind in Japan.

The development of "Seal Maker" is intended to easily automate assembly with packings, for which automation has conventionally been difficult, by automatically coating silicon rubber (highly viscous and liquid).

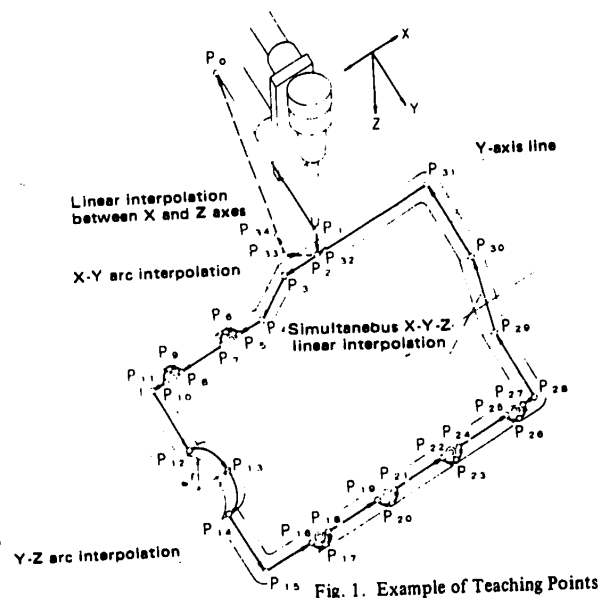
With points on the track, which is desired to seal directly from work, memorized in a control unit equipped with a microcomputer the robot can automatically repeat the track. Because it uses a 3-axis (X,Y and Z) simultaneous driving system, it can deal with automatic coating on objects of any shape.

Other features of the robot include the following:

- (1) It is electro-pneumatic, starting operation the instant it is electrically energized.
- (2) It easily permits correction, cancellation and addition of operations at site.
- (3) It has interpolating functions, has few instruction points and can be "taught" easily.
- (4) It can maintain a constant circumferential speed on any complicated continuous track.
- (5) It has sufficient output and rigidity to coat from 2 heads simultaneously.
- (6) As a rectangular coordinate robot, it provides high interpolating accuracy and allows sufficient space for seal coating.

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SCIENCE AND TECHNOLOGY

RECORDING TRAVELING LOCUS OF AUTOMOBILES

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 68

[Text] * The Machine Technology Laboratory has developed an automatic recording method which permits measurements of the traveling locus of cars to be made with a simple device mounted on the cars.

The method for automatically recording the traveling locus of a car, recently developed by the laboratory, is to measure precisely the speed of both the left and right wheels by use of pulse generating devices mounted on the left and right rear wheels of a car. The locus is then calculated from the resulting measurements obtained. Although the principle of this measurement has been known for a long time, improvements have been made in the method to obtain a precise locus.

The hardware consists of pulse generators serving as car speed sensors, and a data recorder. In addition, automatic control requires a micro-computer, which calculates absolute positions every moment. The pulse generator uses a brake drum with 120 indentations cut on the periphery at equal intervals, with a back plate which uses a combination of a light emitting diode (LED) and a photo transistor. This allows the periphery provided with indentations at equal intervals to be disposed between the LED and the photo transistor.

The rotation of the brake drum causes pulses to be generated photo electrically from the pulse generator, 120 pulses being generated for each rotation. One rotation corresponds to

1.9m for a car of 2000cc class. Traveling distance can be calculated by counting the number of pulse generations. Measurement of the time between the pulses enables velocity to be obtained. Traveling direction (posture angle) can be obtained from the difference between the left and right wheels.

However, this method has some error factors within it. The greatest of which are road surface and traveling conditions. Roughness of the road causes a change in the number of pulses. Curving causes lateral acceleration and alters rolling distances. To solve these problems, two corrections are required. One of them is a correction by calibration points. Calibrating points emitting light or an electromagnetic field are provided beforehand at several points along the source, and they correct errors. The other is a correction for lateral acceleration. In this case, a correction constant is previously obtained and correction is made when lateral acceleration is caused as, for example, traffic lanes are changed. These corrections enable errors to come within several cm.

It is considered that this technique not only serves to raise intelligence of "intellectual cars" (an unmanned car permitting automatic operation with artificial eyes and brains) but also is applicable to the operation system of cars such as an automatic car position observation system (AVL).

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SCIENCE AND TECHNOLOGY

ONE OF NATION'S LARGEST INDUSTRIAL AERODYNAMICS WIND TUNNELS COMPLETED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 69

[Text]

Ishikawajima-Harima Heavy Industries Co. has recently constructed at its research institute a wind tunnel for testing expansion of atmospheric air turbulence. The wind tunnel is the largest of its kind in Japan.

The facilities can be used for conducting various tests, including creation of geographical and environmental conditions similar to the actual conditions at a site, by arranging inside the tunnel a scale model of the topography, investigation of the phenomena of atmospheric expansion of coal dust, the phenomena of atmospheric pollution by exhaust gases from cooling towers, chimneys, aircraft, and automobiles, and the influence of wind on the natural environment can be obtained. Another use of the facilities is for tests involving resistance and stability against wind of large structures such as bridges and high-rise buildings.

By installing the wind tunnel in combinations with additional equipment, such as a constant-velocity adsorbing device for the collection of floating matter like coal dust, and a measuring device for particle diameter distribution, as well as coal dust collectors, such as a wire-mesh net water spray device, coal dust can be prevented from escaping into the atmosphere. Also, by adding a vertical distribution variable device, the flow of wind near the surface of ground can be reproduced, and an addition of a generating device of variable wind-velocity can create the so-called "natural breath of wind."

The computers incorporated in the equipment can perform a succession of data processing work including tests, measurements, and plotting on graphs of the results, thus guaranteeing efficiency and high accuracy in wind tunnel experiments.

The total length of the equipment is 85 meters and the measuring tunnel section is 6m across, 3m high and 24m long. It can create a wind speed with a maximum velocity of 15m/s.

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SCIENCE AND TECHNOLOGY

BELTS FOR CARS REDUCE CAR BODY WEIGHT BY 15KG

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 69

[Text]

Bando Chemical Industries, Ltd. has succeeded in manufacturing a belt for automobiles (brand name: Libace) that can lighten the weight of a car by some 15kg.

Libace is a flat kind of belt that uses neorene rubber as the base material and tetron as cord. It has grooves molded in several lines (the number of lines can be changed depending upon the use) on one side which is used for the transmission of motive power. Compared, with conventional V belts, the recently developed belt has a greatly reduced width, length, and weight. The lighter weight of the belt has not only enabled it to be strapped in a zigzag fashion, for instance from the engine to fan, to generator and to pump for power steering, but also contributes to reducing pulley size reducing weight.

At present, three to four belts are used depending on use such as for the fan, cooler belt, etc. Consequently, the crank-shaft needs to be longer to take a larger pulley, but with the libace, the length of the crankshaft can be shortened 30% since a single or 1.5 width of libace can perform the functions of 4 conventional belts. This also, greatly contributes to shortening the forward section of a car. According to preliminary calculations, the adoption of the firm's new belt brings about benefits in the form of 10kg in reduced engine weight alone and an overall weight reduction of about 15kg accruing from simplified assembly work and reduced noise.

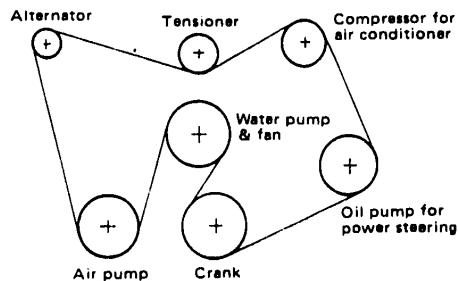


Fig. 1. Layout Using Polyvinyl (Serpentine), Ford Mustang

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SCIENCE AND TECHNOLOGY

HIGH-SPEED ENCAPSULATION DEVICE DEVELOPED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 70

[Text]

* Shikoku Chemicals Corp. has developed a "High-Speed Encapsulation Device" to encapsulate semiconductor devices with liquid resin at super low voltage and at high speed. It is their intention to enter the electronics field together with "FC hard", a one-drop type of epoxyresin encapsulation material that has already been launched.

The newly developed drive has the following features compared with conventional transfer formation:

(1) Less breakage of bonding wire because encapsulation is at super low voltage below one-tenth of transfer formation.

(2) Separation material is not required by the special plastic material which has non-adhesive properties, and which can produce higher encapsulation effect, more reliable products that are both heatproof and shockproof.

(3) Preprocessing, such as pelleting of powder material or high frequency preheating, is not required because a combined liquid en-

capsulation material is used.

The high-speed encapsulation device consists of the material supply unit, metering discharge unit, non-adhesive special plastic mold, holding tool for the mold, and mold feeder. A transport unit and hardening furnace is optional. The mold set on the special tool is put on the feeder and encapsulation material is directly poured into the mold with connection to the air extraction unit. Then it is moved to the hardening furnace in turn.

The main specifications of the prototype are as follows:

Production capacity per month:

200,000 to 1,000,000 pieces

Pouring temperature:

Normal temperature to 50°C

Voltage/current: 100V, 5A

Compressor: 10kg/cm² max.

The price of the main unit is ¥5 to ¥6 million.

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SCIENCE AND TECHNOLOGY

LARGE APERTURE GAP SINGLE CRYSTAL DEVELOPMENT COMPLETED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 71

[Text]

Toshiba Corp. has succeeded in developing an automatic pulling technique under computer control for gallium phosphide (GaP) for light emitting diodes (LED). Dimensions of a GaP single crystal is enlarged to 62mm by this method and at the same time density of substrate defects becomes approximately one-tenth ($10^4/\text{cm}^3$ order) of that by present methods. For red LED, emitting efficiency is enhanced 2 to 3 per cent more than at present available.

This new pulling technique, is a method to simultaneously measure data on many crystal growth parameters affecting manufacture, such as furnace temperature, weight, length, rate of pull, and rotation speed of growing crystal at the time of crystal pulling, and to process it by the computer. This method automates previous manual work and visual checks to increase productivity. Large apertures with high quality are achieved.

In addition to pulling direction (111) crystal, to become substrate material of the red or green

LED's crystal pulling direction (100) to become substrate material of the yellow or orange LED's that previously was totally impossible is now possible up to 62mm diameters and large scale production of crystals can be realized in accordance with present trends for multi-color LED's. The reason that pulling of this GaP single crystal is made under high atmospheric pressure of 70 atms, is to prevent separation of Ga and P under high temperature.

Toshiba developed the large scale production technique for GaP single crystals 52mm in diameter, then the largest aperture, in June, 1980, but this time a 62mm diameter has been realized and further expansion in aperture to 76mm in diameter is planned within one year.

Toshiba is planning to expand the application of the automatic pull technique for single crystals under computer control to the production of Si and GaAs single crystals for the super LSI.

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SCIENCE AND TECHNOLOGY

CAPITAL SPENDING IN ELECTRICAL INDUSTRY REPORTED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 71

[Text]

There is concern that with the slower pace of business, investment in plant and equipment will, generally, be more conservative in 1981, but as far as the electrical industry is concerned, investment (on construction basis) is predicted to continue at a high level. According to the source, of the leading general electric, home appliance, and parts suppliers, each is planning a two-digit percentage increase in investment over the previous year. Most noticeable, is the investment for home VTR's and related products, and the increasing demand for parts and semiconductors has become a factor to push up investments for plant and equipment.

Table 1. Capital Spending for 1980 and 1981 by Major Companies in the Electrical Industry

	1980	1981	Growth rate (%)
Hitachi	720	800	10
Toshiba	495	Over 550	Over 11
Mitsubishi	300	Just below 400	Just below 30
Matsushita	470	Over 610	Over 30
Sony *	480	750	56
Sanyo	280	420	50
Sharp	307	400	30
Nippon Electric *	640	Over 700	Over 10
Matsushita Electric parts	200	400	100
TDK Electronics	260	300	15

Note: The 1980 figure shows estimation of actual spending and the 1981 figure shows approximate or provisional figures.

* Nippon Electric Co., and Sony are based on a consolidated base because their production departments are operated by related separate companies.

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SCIENCE AND TECHNOLOGY

ELONGATED IMAGE FIBER PERMITS DIRECT IMAGE TRANSMISSION

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 72

[Text]

* Sumitomo Electric Industries, Ltd. has developed an elongated image fiber which employs optical fiber production technology to permit direct transmission of images.

This elongated image fiber consists of three parts: 1) the image pick-up optical system (image pick-up part) which picks up the image of a subject, 2) the image fiber integral part, and, 3) the picture optical system (picture part) which projects the received image. The image fiber integral part is made up of approx. 15,000 quartz glass fibers each with a core diameter of about 10 micrometers. They are bundled into a length of approx. 10 meters and each surface is protected by a spiral tube. This company's internal production technology has created about a 10-meter elongation as compared with that of 2 to 3 meters which had previously been regarded as the limit of an image fiber of the multi-component glass fiber

type. It also features small diameter and greater flexibility. Furthermore, this type of image fiber is superior also in terms of the transmission wave-length area and the wave-length loss characteristics, producing a transmission loss of 0.01 to 0.05dB in the case of visible rays, which is 1/100 of the conventional loss.

The main uses of the new product are (1) monitoring the internal surface of pipes or tubes, (2) close monitoring, by means of images, of a 100°C (approx.) high-temperature environment or, if equipped with a cooler, about 1,000°C hot substances, (3) two-dimensional measurements of temperature distribution (500 to 3,000°C) using its wide transmission wave-length area, and (4) use in areas where its radioactivity resistant characteristics can be beneficially employed.

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SCIENCE AND TECHNOLOGY

HIGH-SPEED LSI LIGHT DATA LINK DEVELOPED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 73

[Text] Fujitsu has developed and launched into the market the super-small 32m bits/sec.

The light data link is a bidirectional system that converts digital electronic signals to light signals to transmit them via light fiber, and performs the reverse conversion at the receive side. The realization of a super-small size has been made possible by integration of LSI's and light elements.

The main features are as follows:

1. Small-scale (one-ninth the size of a conventional data link).
2. Transmission speed range up to 32M bits/sec.
3. The refresh pulse method includes an extensive AGC (Automatic Gain Control) function that enables use of the data link without any adjustment for transmission speed. This method regenerates a signal within the receive circuit when the same code (0 or 1) appears consecutively, and ensures detection of the receiving level.
4. The low-distortion encoder and decoder are built in, and synchronous data transmission with high quality is thereby made available.
5. The mounting structure is a print mounting type that is equivalent to a 24-pin DIP. Its height is 7mm.

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SCIENCE AND TECHNOLOGY

DEVELOPMENT OF ACADEMIC INFORMATION SYSTEM EARNESTLY PURSUED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 74

[Text]

• The Ministry of Education is earnestly tackling the development of an "Academic Information System" in fiscal 1981. This system is supposed to connect the libraries or the computer centers of the national and private universities all over Japan to each other and at the same time to supply their documents and their numeric information by connecting to the network the pivot center, which is to be established in Tokyo.

The contents consist of (1) organization of the data base or offer of the manuscripts, etc. concerning the list or the location of the primary information, such as books or academic magazines, (2) distribution of information about international research results, and (3) organization of the data base concerning domestic research results and inputting of the information into the international data base. In 1981 the Ministry is first starting the development of the software of the retrieval/offer system which plays the most important role in the whole system. It also plans to discuss the pivot center organization and how to manage and operate it.

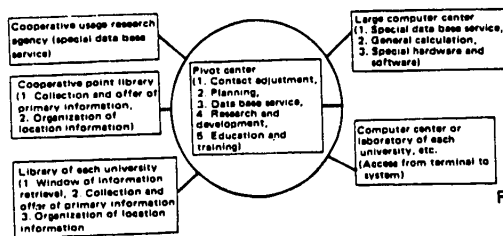


Fig. 1. Concept Figure for Academic Information System

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SCIENCE AND TECHNOLOGY

DEVELOPMENT OF BIOCELL DISCRIMINATION, SEPARATION EQUIPMENT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 77

[Text]

Showa Denko Co. has successfully developed biocell discrimination and separation equipment (by the trade name of "Cell Sorter Shaw-Medic CS-5000").

This equipment applies laser light to biocells, and measures and discriminates the properties obtained from the nature of the cell, enabling the equipment to separate and extract certain cells as the occasion demands. A clinical example has already proved that an experimental model of this equipment can detect at an early stage,

denial reactions at time of liver transplantation.

In the system, a physiological saline solution, etc. is added to the biocell to form a suspended solution. Then laser light is applied to this solution to measure scattered light or light intensity. And those measured values are put into a microcomputer for analysis, displaying various properties, the number, and the distribution pattern of the cells. The system has realized ultra-high speed measurement of up to 5000 cells a second in terms of discrimination.

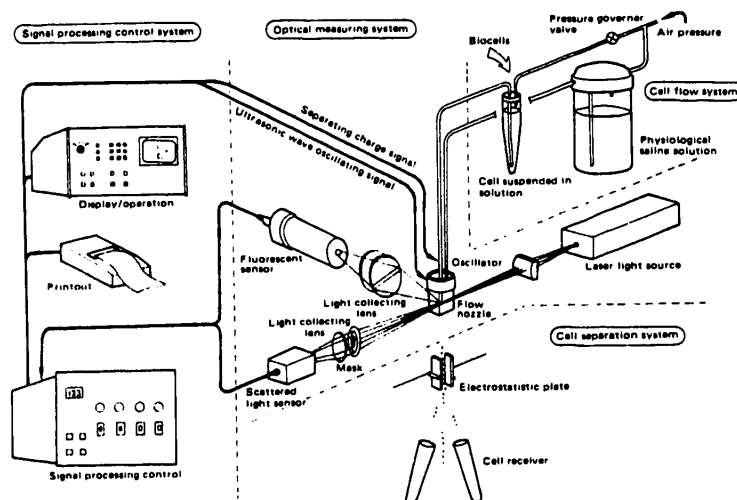


Fig. 1. Constituent Diagram for Biocell Discrimination and Separation Equipment

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SCIENCE AND TECHNOLOGY

AUTOMATIC ANALYZING SYSTEM FOR LABORATORIES

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 77

[Text] Denki Kagaku Keiki Co. has announced plans to sell in May an automatic analysing system for laboratories in which a flow injection analysing method (FIA) is used for the first time in Japan.

The principle of FIA is such that a reagent solution is sent by a constant flow pump to a small tube of approximately 0.5mm in diameter, specimen solution is poured into the reagent solution flow, the both solutions are mixed [as published] by a reaction coil to give a reaction, and then extinction degree of the thus-produced complex substance from the two solutions is automatically measured by an extinction meter.

This equipment of this company is simple in design and structure. Moreover it does high-speed analysis, analysing two or three substances per minute. And only a very small quantity is required as a specimen so that equipment is most suitable for analysis of precious specimens.

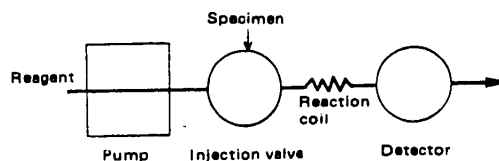


Fig. 1. Principle Diagram for FIA Basic Flow Pass System

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SCIENCE AND TECHNOLOGY

DEVELOPMENT OF METHANOL CHEMISTRY

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 78

[Text] • Mitsui Toatsu Chemicals, Inc. proposed to Malaysia the joint construction of a big industry for methanol. There are many plans to produce methanol as fuel on a large scale by 1985 in USSR, USA, Middle East, Canada, Mexico, New Zealand, South Africa and Malaysia. In Japan, a national project is under construction in Saudi Arabia by Mitsubishi Gas Chemical Co., a leader of the groups.

The resources of coal, natural gas, tar sands, and oil shell in Japan are very few or none, therefore, there are two ideas to import such resources either as raw material later converted into synthetic gas or as intermediate such as methanol.

It is said that the development of C_1 chemicals in Japan will be realized earlier than expected in the fields of oxalic acid, ethylene glycol and ethylene in addition to methanol and acetic acid. It is expected that polyacetal from methanol and formalin will become cheaper than high density polyethylene and be used as a new common resin. Further, new usages of methanol as MTBE, improvement agent for octane value of gasoline, single cell protein and synthetic natural gas are being developed in the U.S.A. and Europe. The C_1 chemistry in Japan will spread with great speed as a methanol chemistry if a continuous supply of cheap

methanol can be obtained.

The amount of coke gas from steel industry in Japan is $5 \times 10^9 \text{ Nm}^3$ a year. If the gas is converted into hydrogen, 6.3×10^7 tons can be obtained. If the hydrogen gas is converted to ammonia or methanol, the calculated values are 3×10^8 tons or 4×10^8 tons respectively. Carbon monoxide gas from oxygen steel furnace is estimated to be 6.6×10^5 tons, then 6.6×10^5 tons of methanol can be obtained by using the carbon monoxide and hydrogen from cooking furnace. By effective use of gas from coking furnace, of gas from oxygen steel furnace and nitrogen from oxygen plant in a consolidated iron foundry, it seems possible to construct super modern factories of ammonia and methanol.

The use of the multiple resources from all over the world is required by Japan in order to get rid of the heavy dependence on naphtha obtained from crude oils of Middle East and also to convert to C_1 chemistry, methanol chemistry.

It seems important to remember that there was a deep connection between iron and organic industry 80 years ago, and to consider again a new combination based on ammonia industry, and new C_1 chemical industry.

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SCIENCE AND TECHNOLOGY

CORROSION TEST OF SUPER HARD CERAMIC WITH THERMAL RESISTANCE

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 78

[Text]

* The Governmental Industrial Research Institute, Kyushu, has been researching a development for "SIALON", super hard ceramic with thermal resistance, and the corrosion test to examine the corrosion resistance against high temperature gas has been started as a laboratory for it was constructed. The research is connected with the Japanese moonlight plan requiring "research and development of high efficiency gas turbine" and is expected to develop high quality ceramic materials as part of a turbine able to endure high temperature gas such as 1,500°C. The research was started in 1978 and the practical use is expected by 1984.

SIALON, sintered material of silicon nitride-alumina system, was developed as the result of a special research done from 1974 to 1977, it has a high strength and a good corrosion resistance even under high temperature. The research to develop a heat resistant super hard material using SIALON for turbine blend and other component is going well. As a result, the manufacturing technology using a hot press and a sintering method reached a final stage. Thus it becomes important to check the corrosion resistance for the developed materials under high temperature like 1,500°C. The testing apparatus were set up in a newly constructed laboratory, 170m² wide.

Continuous corrosion tests will be performed and city gas at 1500°C will be blown against the samples for 20hr under high pressure. According to the test results, further improvement for the materials will be added.

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SCIENCE AND TECHNOLOGY

CONTROL SYSTEM OF POWER PROCESS BY COMPUTER

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 78

[Text]

* Oji Paper Co. has decided to introduce a computerized control system of power process at the Tomakomai factory where more than 400,000kl of heavy oil a year are used and where the electric power system is very complicated. At first the whole electric power used in the factory, hydroelectricity, was supplied from a private power plant, but at present a steam power electric generator and also outside electric power are used because of the increased demands. Therefore, the factory has to use two kinds of frequency, 60Hz from hydroelectricity and steam power electric generator and 50Hz from outside electric power. In order to save energy the company has then decided to control the whole supply of the factory by using a computer of Toshiba Corp. It is expected that the effective use of private power plant and outside electric power, and effective usage of electric power corresponding to a variety of operation will decrease largely the energy cost by the completion of the system.

Daio Paper Co. is the only company among paper and pulp industries that uses a computer on a large scale for electrification plant.

Oji Paper Co. is further considering to control the hydroelectricity in a factory located far from the plant, and to introduce the same system in the other factories. In fact, rationalization of steam power electric generation by introducing a computer system is under way at the Nichinan factory.

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SCIENCE AND TECHNOLOGY

INDUSTRIAL PRODUCTION OF CARBON FIBER TO COMMENCE SOON

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 84

[Text] * Toho Rayon Co., one of the companies developing carbon fiber business, has developed a refractory fiber "Pyromex" (trade name) and activated carbon fiber, and will shortly commence industrial production. According to the company, the refractory fiber is expected to be used for heat-protection suits or as an alternative material for asbestos, and the activated carbon fiber will act as an adsorbent of organic materials or odors. The company has already started supply of an activated carbon fiber water filter to the market. They plan to expand their non-textile business with the new materials.

The new refractory fiber is produced by a process in which carbon fiber is made from polyacrylonitrile. This fiber is provided with sufficient strength and elasticity for spinning and weaving. As for its anti-fire performance, it does not burn even in an atmosphere in which oxygen has been increased 20 percent

higher than normal. Also, its exposure to flame does not cause deterioration of the filaments, but merely a red-hot appearance. Compared with usual refractory fiber, its insulation performance deteriorates little at high temperature. For instance, it has excellent dimensional stability at high temperature. It is durable against chemicals, e.g. organic solvents, weak acids, and weak alkalis. Utilizing these properties, the new refractory fiber is expected to find applications for fire-protection suits and gloves, fire-proof curtains, etc.

The new activated carbon fiber, which is made from acryl fiber, contains a significant amount of nitrogen as a constituent. Therefore, it has particular adsorption properties, especially, it can adsorb mercapto compounds, one of the very odorous gas groups. Its speed of adsorption and adsorption quantity are greater than usual activated carbon, and after repetitive adsorption and re-activation, deterioration of performance is less.

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SCIENCE AND TECHNOLOGY

ELECTRIC CONDUCTIVE FIBER BEGINS COMMERCIAL PRODUCTION

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 84

[Text] * Teijin Ltd. has announced that they have succeeded in development of a dyeable white electro-conductive fiber "T-25", and will start commercial production in spring 1981. The new conductive fiber is manufactured by compounding polyester fiber and a white metallic material developed with the company's special technology. As it can be dyed, and its anti-static electric performance does not deteriorate noticeably, it is being watched eagerly as the new conductive fiber to take the place of current fibers at present in use.

A great problem with synthetic fibers is that clothes made from them adsorb dust or crackle due to static-electricity generated by friction. Usually, the problem has been dealt with by prevention methods, as a second processing method, or a "kneading method" in which static-electric prevention materials are mixed into the fiber, but there are problems with these methods under low temperature condi-

tions. There has also been developed a conductive fiber blending method, but as it uses metallic filaments or carbon powder, uses of the conductive fiber thus processed are limited by reason of its dark colored appearance.

In the manufacturing stage after spinning "T-25", a white metal compound specially selected is added to the outside of the yarn. This method can be used for either the continuous fiber or the staple. With the method, the company has succeeded to provide the fiber with conductivity and dyeability. The electric conductive metallic material does not leave the yarn, and its addition does not affect adversely the excellent properties of polyester fiber. The company has applied for patents in Japan and overseas.

The price of "T-25" cloth, it is said, is 10 percent higher than blended carbon conductive fiber.

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SCIENCE AND TECHNOLOGY

MODEL SYSTEM FOR RECYCLING INDUSTRIAL WASTE UNDER DEVELOPMENT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 86

[Text] • The Ministry of International Trade and Industry has decided to start development of model systems for disposing of and recycling industrial waste. The systems are intended for smaller enterprises and the program starts next fiscal year. In the present situation, in particular, in which smaller businesses find it difficult to acquire sites for disposing waste, the Ministry will promote this development from the point of view of promoting appropriate disposal and effective utilization of waste and will carry out surveys of emissions from smaller businesses for individual prefectures to determine optimal model systems for disposing of and recycling waste in individual areas.

Increases in the load of waste on environment now represents an important problem in the preservation of the environment along with atmospheric pollution and water contamination. On the other hand, in Japan, which has few resources, there is an increasing need for recycling for building up the resources from the point of view of stable development of an economic society. However, recent tightening of environmental restrictions and campaigns against the construction of ultimate disposal plants have made it difficult for individual enterprises, above all smaller businesses, to acquire sites for waste disposal. In addition, it is estimated that about half of the total industrial waste emissions is from smaller businesses and, thus, waste from smaller enterprises is yearly representing an even more serious problem.

Under these circumstances, it is necessary to

recognize the reality of waste from smaller businesses and take effective measures. For this purpose, the Ministry has decided to start development of model systems for disposing of and recycling industrial waste from smaller businesses as part of its policy for effective use and recycling of waste.

The report contains the following points: (1) the responsibility of makers should be clearly stated and retailers should cooperate in joint collection. (2) For the method of collection a makers joint association and the municipality should discuss together without sticking to the deposit method. (3) The responsibility of the mayor should be stated definitely and the methods of collection should be stated in the general policies for measures for controlling scattered garbage and recycling. (4) The responsibility of controllers and occupants in areas of garbage scattering for cleaning should be stated clearly. (5) The installation of automatic can vending machines should be subject to report to the authorities. (6) Can scatterers should be found and for can makers breach of duty to join a can manufacturers association, such measures should be taken as the Mayor's guidance and advice, and sanctions in the form of publication of negligent companies.

A joint association will consist of beverage makers, container makers, automatic vending machine makers, etc. and will be obliged to take measures to prevent can scattering and establish rules for recycling, while sharing expenses appropriately with the Municipality of Kyoto.

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SCIENCE AND TECHNOLOGY

EXPERIMENTS WITH DISSOLVED AIR FLOTATION IN ACTIVATED SLUDGE

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 87

[Text]

In sewage treatment processes treatment of sludge is becoming a serious problem. Sludge produced in sewage treatment systems must be dewatered as much as possible in order to simplify subsequent processes such as dehydration and incineration, for example. A dissolved air flotation (DAF) method is considered to be more favorable than the usual settling tank system in which the solids are separated by gravity.

Ishikawajima-Harima Heavy Industries recently conducted experiments with the DAF method with a view to making it practical. In the experiments, a partial reflux of dissolved air flotation system was used.

The results obtained in the experiments are as follows:

- (1) The float thickened or increased sludge concentration of excess sludge about 3-4% over a wide range of solid loading rates and air-solid ratios and the reaction was not excessive.*
- (2) Mixed sludge can also be concentrated up to 4-5%, but it correlates more to the air-solid ratio than with excess sludge.*
- (3) The removal of suspended solids in any case, reached to 96-98% and the sludge particles were almost all caught by the micro-air bubbles.*
- (4) The dehydration test of thickened sludge by DAF unit shows good results. The moisture content of sludge cake is 76-78%.*

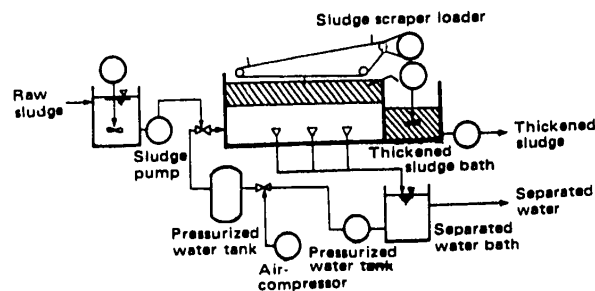


Fig. 1. Flow Sheet of Experimental Equipment

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SCIENCE AND TECHNOLOGY

GOVERNMENT BUILDING UP MARINE DEVELOPMENT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 88

[Text]

* For the purpose of accumulating Japan's own technological skills concerning marine development, the Japanese Government intends to start in fiscal 1981 the overall development of marine technology, particularly promoting research and development with emphasis laid on the following 4 points:

1) Submarine surveys covering deep sea bottoms in the Japan Sea and the Pacific Ocean.

The Government has already started surveyance of sea bottoms near Japan to establish baselines for accurate Japanese territories. In order to make more extensive surveys, the Maritime Safety Agency will build a 2600t class large surveyor on a 3-year plan, starting in fiscal 1981. Also, the Agency will participate positively in the International Program of Oceanic Drilling which surveys oceanic bottoms in the world using a deep sea excavator.

2) Development of resources, including manganese nodules.

The Government will build up surveys of the

deposition of manganese nodules in sea areas to the south of Hawaii, using "Hakuryo-Maru No.2", a ship specially designed for surveyance. Also, in fiscal 1981, the government starts a 7-year plan costing ¥22 billion for the study of techniques for collecting manganese nodules deposited on sea bottoms.

3) Research and development of energy, including wave force power generation and differential-temperature marine power generation.

For differential-temperature marine power generation, which has been under basic study for many years, the Agency of Industrial Science and Technology will start to develop elemental techniques, intending to construct a 1000kW output class pilot plant. It will also start the study of wave force power generation utilizing breakwaters and similar structures.

4) Utilization of Marine Space for Marine Airports

The government has promoted the utilization of marine space, for Kansai International Airport, for example.

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SCIENCE AND TECHNOLOGY

JOINT STUDY FOR CURRENT POWER GENERATION UTILIZING NATION'S CURRENT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 88

[Text] * The Japan Marine Science and Technology Center and the Tokyo Electric Power Co. have signed an agreement for their joint engagement in research and development of current power generation which converts gigantic amounts of energy of the Japan current into electricity, relying purely on Japan's own technology for power generation.

They are planning to manufacture a test plant for Savonin's rotor type fully submerged current power generation, which is commonly called "the Kaiho rotor system" and to establish foundations for making it practical by conducting tank tests and current tests. No substantial study of current power generation has been attempted in Japan.

The Kaiho rotor type current power generation plant consists of a generator with an extended rotary shaft lewing from both sides and a cylindrical rotary wheel (rotor water wheel) fitted on each of both shaft extensions. When installed in a current with a submarine cable attached to it, the entire power generation plant "soars" in the current, just as a rotary kite flies in a wind, and the wheels rotate to generate electricity. If the current changes its direction, the plant follows it just as smoothly as a kite follows a wind. If the plant is operated about 100m deep in the sea, it will not interfere with ships and will not be disturbed

by bad weather or typhoons.

The joint research will include the manufacture of a 10W output small sized generator using 2 rotary wheels 30cm in diameter and about 60cm in length, a test using a large current simulation tank and, finally, a test in a real sea area to obtain the extensive data necessary for making the plant practical.

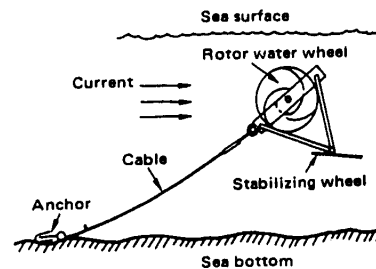


Fig. 1. Model Diagram for Kaiho-Type Current Power Generation

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SCIENCE AND TECHNOLOGY

SUCCESSFUL TEST OF AIR-LIFT COLLECTOR OF MANGANESE NODULES

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 89

[Text]

The National Research Institute for Pollution and Resources has recently succeeded in a marine test of an air lift (bubble pump) type collector, which is expected to be a representative system for collecting manganese nodules.

The air lift system uses a thick pipe extending to the sea bottom, feeds compressed air into it through openings provided in it and sucks manganese nodules from sea bottoms up to boats by making use of the buoyancy of the injected air. This system has the advantages over other systems of causing less trouble during operation and of showing higher efficiency of collection, and it is expected to become a representative technique for collecting manganese nodules.

The air lift system has a flow in the pipe of a mixture composed of a solid (manganese

nodules), a liquid (seawater) and a gas (air) and the air in the pipe expands as it comes up to the surface of the seawater. Thus, in order to achieve efficient collection and transportation of manganese nodules, such factors as the gauge of the pipe, flow rates and rates of air injection must be strictly designed. In order to make the plant practical, basic data are needed for the appropriate combination of these factors. The latest marine test was intended to obtain such basic data.

The pipe of the air lift used in the test was about 40m long and about 15cm in diameter. The test fed a light-weight aggregate (with a mean grain diameter of 3.5cm and a specific gravity of 2) in simulation of manganese nodules into the pipe at a lower location and observed how it was brought up by bubbles, successfully obtaining data on transportation speed, transported quantity, etc.

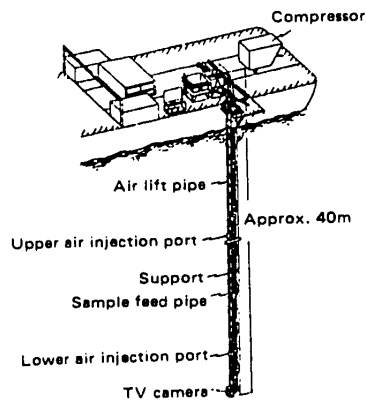


Fig. 1. Test Setup for Air Lift System for Collecting Manganese Nodules

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SCIENCE AND TECHNOLOGY

SEAWATER DESALINATION PILOT PLANT BASED ON REFRIGERATION USING LNG'S LOW HEAT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 89

[Text]

Mitsui Shipbuilding has recently developed a seawater desalination pilot plant based on refrigeration using low heat of LNG and has delivered it to the Ministry of Trade and Industry.

Because of the recently tense situation in the demand and supply of water, the development of water resources, particularly the desalination of seawater, is increasingly expected. Since conventional technology for the desalination of seawater required large energy consumption, the development of seawater desalination systems which consume energy modestly or which can utilize unexploited energy effectively has been much expected.

On the other hand, LNG, which is being imported in strikingly increasing quantities because of soaring prices of crude oil, is liquefied at its original sites, carried to reservoir bases by specially provided tankers and returned into natural gas by evaporation before use. Seawater has almost always been used as heat source for this evaporation, and low heat has most been emitted into sea without being utilized.

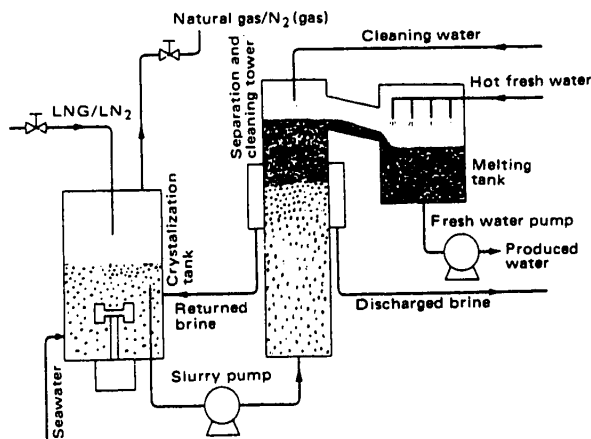
In order to solve these problems comprehensively and to obtain efficiently inexpensive fresh water from seawater, the seawater desalination pilot plant based on refrigeration using low heat of LNG has been developed.

The plant is based on the following principles. LNG at an ultra-low-temperature (-161.5°C) is brought into direct contact with seawater to produce crystal ice in seawater. This ice is separated from brine, cleaned and melted into fresh water (see Fig. 1).

The main specifications of the plant are as follows: 1) Capacity: $10\text{m}^3/\text{day}$
2) Quality of produced water: below 500ppm.

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Fig. 1. Diagram Showing Principles of Seawater Desalination Using Low Heat of LNG/LN₂

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SCIENCE AND TECHNOLOGY

NEW MAFF RESEARCH THEMES DETAILED

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 92

[Text]

* The new research themes of the Ministry of Agriculture, Forestry and Fisheries (MAFF) for fiscal 1981 are as follows:

Biomass Conversion Project (general research concerning the development of techniques for the efficient use of biological resources): The regenerative capacity of biological resources and the buffer functions of forests, soils and micro-organisms will be clarified by analyzing the distribution of biological resources by items, and determining the amount that can be used, the amount that is not yet used and the amount that can be regenerated. Furthermore, efforts will be made to make possible the mass cultivation of grain amaranth, water hyacinth and large algae and to establish methods for opening up new areas of use, such as leaf protein, fermentative protein and wood chemicals. Also, small-scale, high-efficiency energy converting equipment that can be used in farming, forestry and fishing communities will be manufactured using techniques to recover matter and energy from such waste products as chaff, waste materials and livestock excrement. Techniques to locate and produce high-activity micro-organisms and enzymes and to fix enzymes, will be included as will membrane treating techniques using high polymer materials. These techniques, when developed, will provide 15.7% of all energy required by agriculture, forestry and fisheries. Under this long-range project, to continue until fiscal 1990, ¥240 million will be spent in fiscal 1981.

Development of Methods to Evaluate Safety of Animal Fodders and Microbic Fodders: Methods will be established to evaluate the safety of fodders containing microbic protein (SCP), which has a promising application as a proteinous component of fodder, fish meal or

livestock industry by-products. For this purpose, polluting salmonellas will be identified and their quantities and pathogenic properties clarified. Thereby, a simple testing method to determine the degree of toxicity that may occur in manufacturing and distributing fodders will be devised.

Emergency Techniques to Cope with Oil Conservation in Greenhouse Cultivation: An estimated 900,000 to 1,000,000 kl/year of oil is used for heating in greenhouse cultivation and the consumption is believed to be increasing by 2 to 3% each year. To ensure the steady development of greenhouse horticulture, therefore, it is necessary to establish a methodology to reduce oil consumption by selecting plant types resistant to low temperature, improving cultivating methods and improving heat insulation. The project proposes that specific studies related to this issue be conducted mainly by the National Institute of Agricultural Sciences.

Establishment of Waste Water Treating Techniques for Rural Communities: Water pollution resulting from industrial development is now a social problem, and there is the growing danger of rivers being polluted due to inadequate waste water treatment in rural communities. The project proposes to provide simple treating facilities and, at the same time, develop techniques aimed at recycling the soil biosystem by returning useful substances to farmlands.

Establishment of an Optimum System to Increase the Operating Efficiency of Coastal Fishing Boats: Research and development will be made of basic factors, such as hull structure, engine, fish finding techniques and the storage of catches, all of which are indispensable for the efficient operation of a coastal fishing system. Furthermore, guidelines for efficient

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coastal fishing will be prepared by simulating particular types of ships equipment.

Development of New Preserving Techniques Suitable for Processed Foods: This project includes the development of safe additives of natural origin, the use of new enzymes and the development of gas substitution packing techniques and a germ-free packing technique using accelerated electronic rays.

Clarification of Pathogenic Mechanism in Preparation for the Development of a New Technique for the Prevention of Pine Withering: This project is an effort to discover a method to really control the pine withering disease by studying the formation and activity of its underlying toxic substance, thus revealing how it starts and spreads.

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SCIENCE AND TECHNOLOGY

DEVELOPMENT OF NEW METHOD TO PREVENT FALL-OFF OF INCORPORATED GENES

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 93

[Text]

The central laboratory of Ajinomoto Co. has developed a process to substantially prevent the "fall-off of incorporated genes", which has been a bottleneck in actually applying the gene recombining technique to production.

With the advance of gene engineering, it has become possible for target genes to be incorporated into microorganisms, for example, with relative simplicity by using special enzymes and gene carriers called vectors. Interferon, expected to have a carcinostatic effect, and growth hormones can be produced at low cost by simply culturing these microorganisms in a tank. However, it often happens that even if genes produced by interferon, etc. are incorporated into such microorganisms as colibacilli, the incorporated genes fall off during culture and the microorganisms return to the state of ordinary microorganisms.

At the laboratory stage, therefore, the "fall-off prevention" method using antibiotic-resistant gene vectors (carriers) is now commonly used. This method involves some fear of the product containing antibiotics since antibiotics are added to the culture solution of microorganisms. In the case of amino acids, produced by the Ajinomoto Co., there has been the problem that amino acids and antibiotics mingle together because amino acids go out of the bodies of microorganisms into the culture solution and it is too expensive to separate them.

In the new method developed by this company, special colibacilli that cannot live without antibiotics are used as target microorganisms of gene engineering. In this case, vectors that can live without antibiotics are used as vectors of gene engineering. In other words, the combination of colibacilli that cannot live without antibiotics and vectors that can live without antibiotics is the basic composition of gene engineering (see Fig 1). Target genes, such as genes producing amino acids, are united with vectors in this combination and then incorporated into colibacilli requiring antibiotics. Then, these colibacilli produce target amino acids, etc. and, at the same time, turn into a stage where they can, by the action of the vectors, live without antibiotics. Consequently, they can be reared in an ordinary culture solution not containing antibiotics. The vectors and the target genes are so strongly united that if the target genes fall off the fungus bodies, the vectors fall off with them and the colibacilli return to the state where they cannot live without antibiotics. If, therefore, target genes incorporated by gene engineering fall off, the bacteria in the ordinary culture solution will perish.

Thus, all microorganisms that have survived in the culture solution are microorganisms that incorporate target genes. Furthermore, microorganisms multiply so fast that even if only one out of tens of thousands survives, it instantaneously multiplies to fill the tank and thus, effectively there has been no fall-off. The central laboratory of Ajinomoto Co. has experimentally proved that this idea is correct.

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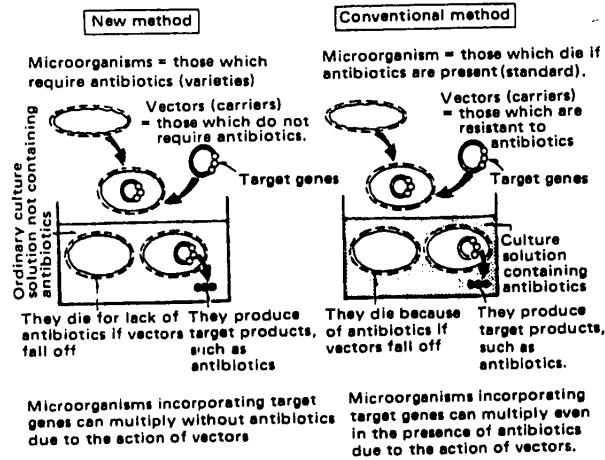


Fig. 1. Comparison of New Method with Conventional Method

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SCIENCE AND TECHNOLOGY

EXPERIMENTAL MULTIPURPOSE HTGR PRACTICALLY ON TARGET FOR 1988 CRITICALITY

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 58

[Text] • The Japan Atomic Energy Research Institute, (JAERI) in promoting the development plan for a multipurpose hot temperature gas cooled reactor, last year initiated the detailed design for a 50,000kW, experimental reactor.

The nuclear steelmaking project aiming at utilization of the reactor heat by reduction, by MITI's Agency of Industrial Science and Technology, was terminated in the previous fiscal year, which somewhat clouded the future of the multipurpose HTGR. Nevertheless, JAERI determines to concentrate on research and development for the construction of an experimental reactor, maintaining that the nuclear capability will in due course have other applications than power generation. In 1969, the institute began R&D of components technology such as fuel, materials, and high temperature resistant equipment. Since fiscal 1978,

a large structural components reliability test loop has been set up to establish technology for the gas reactor components. Using this technology, the design detail for an experimental reactor is now underway starting in the last fiscal year.

According to JAERI's work so far, the reactor will be a 50,000kW, helium gas cooled, graphite moderated type using slightly enriched uranium in characteristic pill-like fuel particles. In 1979, JAERI ordered a comprehensive system plan for the experimental reactor from four nuclear component manufacturers with Fuji Electric Co. being appointed technical integrator. The task was completed last year and the detailed design will now go into the concreting equipment structure stage as well as the setting up of overall operation/safety programs. The institute is aiming to achieve criticality by 1988 at the earliest.

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SCIENCE AND TECHNOLOGY

JOINT EFFORTS WITH U.S. IN RTNS PROJECT

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 58

[Text]

- Japan and the U.S., who are both stepping up their concerted nuclear fusion reactor development activities, have recently launched a joint experimental "RTNS Project" to study core materials utilizing a large-scale accelerator made in the U.S.

This giant device is the RTNS at the Lawrence Livermore Laboratory (LLL), and the two countries will conduct irradiation tests on the core wall and other materials over a period of 5 years from fiscal 1981, along with participation in the construction of RTNS2, new accelerator under construction. Based on the agreement for Japan-U.S. nuclear fusion research cooperation signed in May, 1979, the first Doublet III project really took off as a cooperative scheme, producing numerous results like plasma characteristics. The core material joint development plan using the experimental facility is the next largest to Doublet III, and is expected to be just as productive.

Should Japan build an accelerator of the RTNS scale, it would cost a total ¥4 billion and require a five-year period of construction. Therefore single-handed core material development by Japan might take too long to be desirable in this field. Therefore, this collaboration by both countries can be viewed as another primer to boost thermonuclear reactor development as quickly as possible.

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SCIENCE AND TECHNOLOGY

SUPERHIGH HEAD PUMP-UP POWER GENERATION

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 57

[Text] The Tokyo Electric Power Company together with three heavy electrical equipment makers, Hitachi Ltd., Toshiba Corp., and Mitsubishi Electric, has found it technically feasible to develop a superhigh head pump-turbine that enables pumped-storage generation with a head over 100m. Since the economy of this type of turbine improves in proportion to the head, nations in the world have been competing for use of higher heads; this is the first breakthrough beyond the 1000m mark.

As nuclear power generation will increasingly be emphasized year by year, so will the necessity of pump-up electricity production. The construction cost of such a power plant inevitably differs with different topography, geology, and other regional conditions. With those fixed, assuming that the cost for six 200MW power stations with a fall of 300m is 100, then it would drop to 75 for four 300MW units at 500m, and further to 60 for three 400MW units at 800m. Although each firm is expected to build for the time being the higher head plants up to 800m with conventional techniques, even higher is possible owing to the new technology for over 1000m. The superhigh head pump turbine recently developed by the four companies is referred to as a two-stage model with movable guide vanes, an entirely new item in this field, which provides upper and lower impellers as illustrated in the figure. In a sense, the structure arranges two conventional pump turbines, and both impellers have movable guide vanes that control the amount of water to be applied to themselves. In Italy, e.g., a two-stage type has recently been developed, but it lacks the mechanism to regulate the amount of water such as these guide vanes, the feature of the new turbine.

With no control over the amount of water, there is no governing of output; without installing a mass of smaller units to regulate the number of operation, the power of the generating facility could not be managed.

This novel two-stage pump turbine enables output regulation and construction of larger scale variations to accommodate heads up to about 1,100 m. Namely, in the case of 1,100 m, the upper turbine utilizes a head of 550m with the lower unit handling the rest, so that the twin turbines each for a 600m head can generate 400MW at 1,100m.

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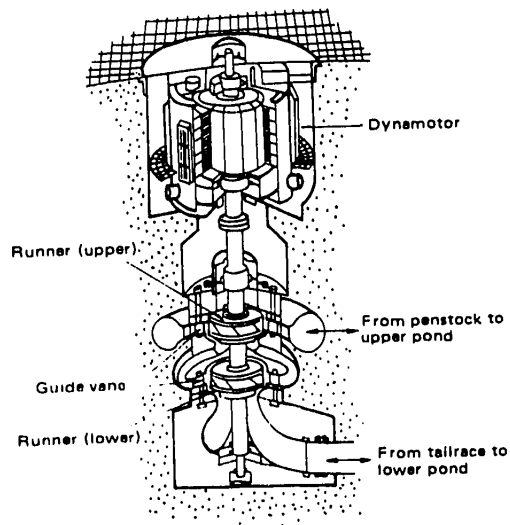


Fig. 1. Diagram of a Two-Stage Pump Turbine with Movable Guide Vanes

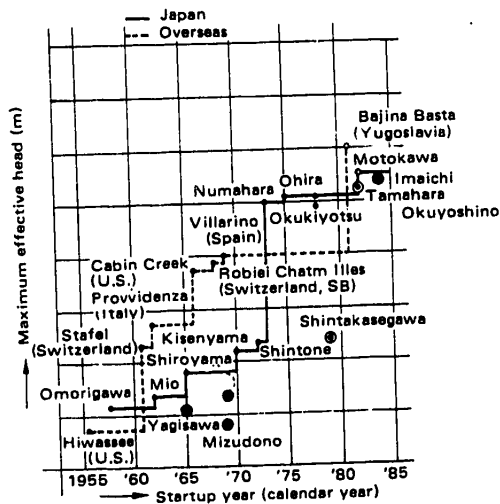


Fig. 2. Progress of Maximum Effective Head in Pump-Up Power Generation

Moreover, current 500m-head class pump turbines must use impellers with 4.7m O.D., and as heavy as 45 tons, in contrast to the two-stage version that uses impellers of 3.5m O.D., 25 tons or so in weight, for 1000m head. This will greatly facilitate their transportation, and Tokyo Electric expects that the equipment is also available for sites far up in the mountains.

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SCIENCE AND TECHNOLOGY

SYNTHESIS OF THERMALLY STABLE OILS BY BENZYLATION OF BIPHENYL WITH BENZYL CHLORIDE CATALYZED BY IRON (III) OXIDE

Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 pp 51-53

[Text]

The benzylation of biphenyl with various amounts of benzyl chloride was performed at 80°C or at room temperature in the presence of iron(III) oxide prepared by calcining, at 300°C, iron(III) hydroxide which has been precipitated by hydrolyzing FeCl_3 with ammonia. The products with various viscosities were thermally stable up to 200–300°C, and no chlorine was detected in the products.

Several works concerning the decomposition of PCB by methods using pyrolysis,¹⁾ radiolysis,²⁾ photolysis³⁾ and plasma⁴⁾ have been reported. On the other hand, some workers have investigated the alkylations of biphenyl in the presence of Friedel-Crafts catalysts in order to use the products as liquid heat stabilizers.^{5,6)} Biphenyl is also used as a high-boiling heating medium by mixing it with diphenyl ether as a liquid at room temperature.⁷⁾ Previously, M.Hino and K.Arata (Hakodate Technical College) reported that the iron(III) oxide thus prepared is an exceedingly effective catalyst for the polycondensation of benzyl chloride, and that the product is poly(*p*-phenylenemethylene) and stable up to 400°C.⁸⁾ In this work, they reported that thermally stable oils with various viscosities can be easily synthesized by the benzylation of biphenyl with benzyl chloride in the presence of the iron(III) oxide catalyst.

The iron(III) oxide catalyst was prepared by calcining iron(III) hydroxide in a glass tube in air at 300°C for 3h; it was then stored in a glass ampoule until use. The iron(III) hydroxide was precipitated by hydrolyzing FeCl_3 with aqueous ammonia. The hydroxide was washed, dried at 100°C, and finally powdered below 100 mesh. The benzyl chloride (guaranteed reagent of Wako Pure Chemical Co.) and biphenyl (Wako Pure Chemical Co.) were used without further purification.

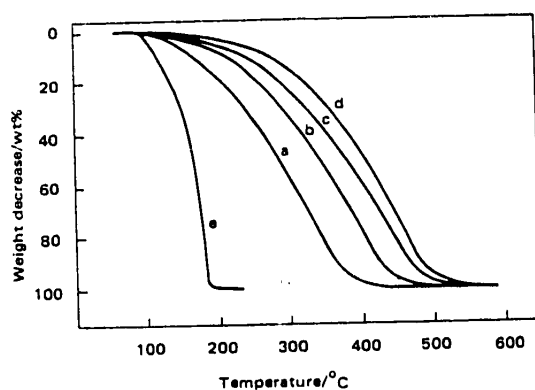
Benzylation was carried out in bulk following two methods: (A): 10–60ml of benzyl chloride were stirred, in 2-ml portions, into a mixture of 20g of biphenyl (mp, 70°C) and 0.1g of the catalyst at 80°C. Each reaction occurred immediately, with a violent evolution of HCl. Benzyl chloride was added at intervals of 10–30s for the first 20ml, and afterwards at 1–2min intervals, without any additional catalyst. (B): 10–50g of biphenyl were dissolved in 50ml of benzyl chloride at room temperature, after which the benzylation was performed by

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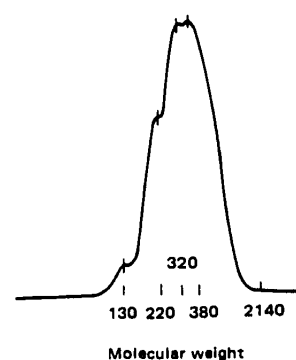
Run	Amount of benzyl chloride	Amount of biphenyl	Reaction temperature	Yield	Viscosity ^{a)}
	ml	ml	°C		η/rel
1	10	20	80	25	2.76
2	20	20	80	34	3.37
3	40	20	80	47	4.74
4	60	20	80	60	5.97
5	50	10	RT ^{b)}	43	8.95
6	50	20	RT	53	5.58
7	50	30	RT	65	3.88
8 ^{c)}	50	50	35	82	3.31

- a) Relative viscosity of a 50wt% benzene solution to benzene determined at 25°C in a Cannon-Fenske viscosity.
b) Room temperature. c) Since the biphenyl was not all soluble in benzyl chloride at room temperature, the reaction was carried out at 35°C.



a, b, c, and d refer to the products given by Runs 2, 3, 6, and 4, respectively. e: Biphenyl, heating rate: 5°C/min.

Fig. 1. TG Curves of Products



Concentration: 0.4g in 100ml of THF, flow rate: 1ml/min.

Fig. 2. GPC Curve of the Sample Produced by Run 3.

stirring with 0.2g of the catalyst. The reaction started immediately, with an evolution of HCl gas, and was completed within 7-10min in every reaction. After the reactions by both methods, the reaction mixture was diluted with benzene, separated from the catalyst by filtration, washed with water several times, and dried; finally the benzene was removed by vacuum evaporation.

Table 1 shows the yields and viscosities of the products. Brownish oils with various viscosities were obtained in high yields depending on the amount ratios of benzyl chloride and biphenyl reacted. In the cases of excess amounts of benzyl chloride (Runs 3-6), the products are considered to also contain poly(*p*-phenylenemethylene), judging from the high activity of the catalyst for the polycondensation of benzyl

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chloride to poly(*p*-phenylenemethylene).⁸⁾ Elemental analysis showed no chlorine in any of the products in the table. NMR spectroscopy showed a single peak at 3.85ppm (CH₂) and a multiplet at 6.7-7.5ppm (phenylene H) in the ratio 1:7 for the samples in Runs 2 and 8.

The TG analysis of the products were done in nitrogen; some of the results are shown in Fig.1, together with that of biphenyl. The products were thermally stable up to 200-300°C, above which decomposition occurs, and they decomposed completely at 550°C. The weight decrease in biphenyl was 100% below 200°C.

The molecular-weight distribution of the sample in Run 3 was determined by gel-permeation chromatography, as is shown in Fig.2. The main products have a molecular weight of 220-380; this indicates that the degree of the benzylation of biphenyl is predominantly 1-3.

The present synthesis was carried out with AlCl₃ and FeCl₃, typical Lewis acid catalysts, under the same conditions. The reaction was complete when 28ml of benzyl chloride was added, in 2-ml portions, to a mixture of 20g of biphenyl and 0.1g of AlCl₃ at 80°C. However, further reactions did not occur with additional benzyl chloride, in spite of another addition of the catalyst. It is considered that the oily product poisoned the acidic sites of the catalyst surface. Another run was performed at room temperature with 30g of biphenyl dissolved in 50ml of benzyl chloride and 0.2g of FeCl₃, but the reaction was extremely slow; 1.38% chlorine was detected in the product after a reaction of 45min.

The product obtained by the present easy method of synthesis with the conventional and active iron(III) oxide catalyst can replace PCB, whose synthesizing method is to liquidize biphenyl by chlorination. The present method could also be applicable to naphthalene as well as biphenyl, both of which are produced in great quantities in petroleum industries.

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SCIENCE AND TECHNOLOGY

BRIEFS

50-DAY LPG STOCKPILE--The Ministry of International Trade and Industry (MITI) has announced to revise the part of the petroleum stockpiling law that imposes the reserves of LPG that importers, must keep and to implement related support measures. LPG for household use and taxicabs is supplied chiefly from the Mid-East and is two thirds of the demand; as with crude oil, Japan is to raise her LPG stockpile. The target for end of F.Y. 1981, the plan goes, is 15 days equivalent of imports, adding a 5-day amount each year and thus a 50-day reserve by the end of F.Y. 1988 is the target. Outlines of LPG stockpiling include: (1) revising the petroleum stockpiling law to impose keeping reserves by importers; (2) setting up stockpile goals for each fiscal year end with the figures based on the import amounts of the previous year--15 days for end F.Y. 1981 followed by 5 days increase for each subsequent year and finally 50 days for end F.Y. 1988. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 56] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

CEMENTING COAL ASH--The Electric Power Development Company has developed a treatment process for coah ash, which had been a difficulty with coal-burning power generation, now regarded as Japan's alternative energy source next to nuclear power. The civil engineering laboratory of the company added cement and plaster to cinder ash (coarse ash) which is more than 70% of coal ash, to successfully prepare a cemented body with sufficient strength for concrete for public works and construction purposes. According to the government's objectives for oil alternative energy supplies decided at the cabinet meeting at the end of 1980, 69 million tons of general coal will be furnished in F.Y. 1990, mostly for electric power production, with the rest for the cement and paper pulp industries. The problem is that about 20% of general coal becomes ash to spew out the vast amount of approx. 13 million tons each year by around F.Y. 1990. Coal ash is roughly divided into sandlike clinker (so called cinder), cinder ash, and fly ash. Clinker accounts for 20% of coal ash, and is a valuable material for land reclamation because of its excellent drainage ability. As for fly ash, 10% of the total, the use is already complete as an ingredient of cement. Cinder ash as well as bottom ash has been a "white elephant" and until now of no practical use. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 56] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

CRUDE SOLIDIFICATION STOCKPILE--Government sources say that solidified crude oil stockpiling will be realized under a "wax crude and heavy oil solidification & stockpiling system." Normally, wax-rich crude solidifies and needs heating to be stored. The system, paradoxically, takes an advantage of the phenomenon to reserve natural solidifying crude as it is for the first time in the

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world. Subsidized by MITI as one of the important technology development research, Nippon Steel Corp. and the Energy Engineering Co have the green light in fiscal 1978 and 1979 after conducting studies. Based upon the conclusions, Nippon Steel has decided to build a 10,000kℓ demonstration tank in Aichi Prefecture, and if the results are favorable, it intends in future to construct a 7 million kℓ solidification storage tank complex consisting of 35 tanks of 200,000 kℓ capacity each. Japan is at present erecting a water-sealed, oil stockpiling demonstration plant, in addition to a new firm to be established shortly for a floating oil reserve, quickly adopting new stockpiling systems, which all promise the future of solidified stockpiling. The method features: (1) low probability and limited scale of accidents due to vaporization, spill or diffusion; (2) no sludge deposits which dispenses with periodic tank cleaning; (3) relieved requirements for perpendicular storage tank walls; (4) eased countermeasures to wind, rain, and snow owing to the roof being free of vertical movement; (5) discarding need for tank bottom plates etc. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 56] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

PRACTICAL WIND POWER HEATING--The technical laboratory of Komatsu Ltd has been studying an agitation type wind power heating device that directly converts wind energy into heat, and has succeeded to develop and install the first practical unit in Shizuoka Prefecture. Currently, the firm is conducting hot water supply tests coupled with data acquisition, hoping early commercialization if the performance is acceptable. The development of wind power use has centered on electricity generation, whereas recently, more efficient direct heat conversion has drawn attention. The Science and Technology Agency, with its "Wind-Topia Project II," also aims at the development of their "Wind Power--Thermal Energy Utilization System," a five-year plan starting in fiscal 1980. The structure of the system comprises a 15m steel tower with a 15m dia., three-vane windmill on its top, as well as a churning type heater and accelerator (9 times). The windmill begins to turn at a wind velocity of 3.5-4 meters per second, and keeps a steady revolution of 72 r.p.m. at 8m/s or more, producing 25kWt at 8m/s. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 56] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

SILICON SOLAR BATTERY EFFICIENCY--Professor Hamakawa, the Faculty of Engineering Science of Osaka University, has developed 2mm dia., small area type, amorphous silicon solar batteries to achieve a photoelectric efficiency of 6.53%, the result being better than previous tests. Amorphous silicon solar batteries require less raw materials, simpler fabrication steps together with less energy for production, and being spot-lighted as low-cost, energy-saving solar batteries, only short of satisfactory conversion efficiency. The professor has found a method to add hydrogen to silicon carbide in the P-layer on the top of the triple layer structure to improve the efficiency. Its technical feasibility is excellent since materials employed and manufacturing process remain intact. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 56] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

MARINE NUCLEAR POWER PLANTS SURVEY--In an effort to build nuclear power stations in the sea to help, if only slightly, relieve the siting difficulty, the Ministry of International Trade and Industry (MITI) is to probe into the possibility of constructing full-scale maritime nuclear plants in a four-year scheme starting

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in Fiscal 1981. The conceived plant would be constructed using a dock system around 20-150m deep. It is hoped it would represent a power source of modest scale which could be located in the neighborhood of a few electricity consuming regions. Accordingly, MITI will soon organize an investigation committee for offshore nuclear power plants to study the four types namely: (1) floating, (2) on-bottom, (3) island, (4) caisson. The study will include potential sites, different power transmission systems, as well as factors such as safety and economy. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 58] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

SYSTEM DECONTAMINATION OF RADIOACTIVITY--The Tokyo Electric Co. is becoming confident of the technical practicability of a "system decontamination" that will reduce the radioactivity levels of an entire nuclear power facility. The system decon development has been urged not only to ease plant operation but to minimize the exposure to workers. The company has now to formulate the final report on the decon method, costs, etc. However, there is no example of its implementation anywhere in the world so that a definite schedule and a potential nuclear power station subject etc are still undecided. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 58] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

OPERATORLESS PLANT WITH SELF-CONTROL--Leading electronic equipment and parts makers in western Japan, including Matsushita Electric Industrial Co., Sanyo Electric Co., Sharp Co., Matsushita Electronic Parts Co., and Omron Tateishi Electronics Co. have agreed to develop jointly an operatorless plant by putting together their own production technologies and making full use of computers. The project, called SELCAM (self-learning computer-aided manufacturing), is a 3-year plan which starts in fiscal 1981 backed by the Western Japan Electronic Industry Promotion Center and will have a total budget of ¥0.5 - 1 billion. The project aims at creating an operatorless plant, or a plant made ultimately intelligent. This does not simply mean the automation of production lines but aims to complete an overall automatic production system including such jobs as receiving orders, production planning, and shipment. Thus, the project intends to establish a method of designing a total system which controls all load plants by using the data bases of a large-capacity computer which is installed in the head office. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 64] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

ENAMEL COATING ROBOT--Kobe Steel, Ltd. has developed a robot for enamel coating, the first in Japan, and will start receiving commercial orders in 1981. The enamel coating robot consists of a main unit equipped with a manipulator, a hydraulic unit, and a control panel. The manipulator has actions similar to human arms and hands, and performs all motions similar to arm swings, wrist bending and twisting, and finger opening and closing, automatically. First, a skilled worker operates the machine manually to teach the machine how to coat an object, together with any particular "knack" required and then the machine continues coating under control of micro-computer. The robot shows the following features. It is capable of uniform coating, being level with a skilled worker. Because it uses a microcomputer, it can be applied in various kinds of coating by simply changing programs, and thus is suited to multi-line small-lot

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production. Although it cannot operate as speedily as a skilled worker, it can work 24 hours and in the long run can achieve higher productivity. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 64] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

RANGE OF INDUSTRIAL ROBOTS--In Japan, the demand for industrial robots has been increasing, with production showing an annual growth rate of around 50% over the last 2 years. At the same time, the demand for robots has rapidly become more varied as industry expands adoption of automation and labor saving. Under these circumstances, robot makers are expanding their production facilities. Shin-Meiwa Kogyo Co., a leading maker of arc welding robots, in addition has decided to expand into such fields as shearing robots, which will shear steel plates, handling robots for presswork, and fuse-cutting robots. Shearing robots, for which the company will shortly start receiving orders, are able to cut out products of various shapes from identical steel materials under automatic computer control for all processes including cutting and stacking. They can cut steel materials up to a size of 1219mm by 2438 mm, 6 mm thick, with an accuracy of 0.5 mm. Handling robots, which the company developed recently, hold a steel plate by using a handling device provided with pneumatic suction disks, and feed the plate into a press. In addition to these, the company will put into critical use fuse-cutting robots, by making use of technology for welding. Robots which can handle gas cutting of steel plates have already been used in some automated equipment. And now, new robots which are capable of 3-dimensional cutting are ready to be made practical. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 64] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

PORTABLE SEAWATER DESALINATION SYSTEM--Japan Electronic Materials Corp. has received a large number of inquiries about the world's smallest portable water purification system that the company developed as a commercial product for export. Thus, they have standardized their product and started marketing it under the tradename "Compact Water Purifier PURER." The system uses an inverse-osmosis membrane and has such high performance as to remove salt content in 3.5% salt seawater up to 98.5-99%. It can be carried in a small vehicle, and is half the size and a third the price a seawater purifier of American manufacture. The system has the following specifications: (1) Hourly water production capacity: 45l/h from river water, and 17l/h from seawater; (2) External dimensions: 660mm wide, 450mm deep and 450mm high; (3) Weight: 50kg; (4) Power supply: 100-110V AC; (5) Wattage: 1.1kW. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 65] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

1M-BIT MAGNETIC BUBBLE MEMORY--In order to increase the memory capacity of NC equipment, Fujitsu Fanuc uses 1M-bit magnetic bubble memories in its products. In these memories, the magnetic properties of GGG (Gadolinium Gallium Garnet) are used and these memories are non-volatile memories in that the contents are retained even after the power is switched off. They also feature higher reliability than IC memories due to GGG's greater stability. On the other hand, the new memories have a weakpoint in being expensive because of the material GGG, but recently this price problem has been settled by the use of super fine machining techniques developed for modern semiconductor manufacture. Actually, a 1M-bit magnetic bubble memory has the same capacity as 16 times a 64 k-bit RAM

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(Random Access Memory) while the price per bit of a 1M-bit magnetic bubble memory now is the same as that of a 64 k-bit RAM. Under these circumstances, magnetic bubble memories are being introduced to the NC equipment industry on a broad basis. Following behind Fujitsu Fanuc, Yasukawa Electric Mfg. Co. will soon merchandise their new X series NC equipment having a magnetic bubble memory, while Mitsubishi Electric Co. plans production of similar NC equipment. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 66] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

ION BEAM EQUIPMENT--The Institute of Physical and Chemical Research has begun development of an ultra fine high-brightness ion beam equipment for super LSI production. The Institute plans production of the ion beam equipment and large scale production of super LSI. The plan starts in April 1981 and it will take 3 years to complete. Now, modern super LSI's are manufactured by a mask-process based on an electron beam exposure system. This manufacturing system is basically the same as electronic circuit pattern production for IC's and LSI's and has a poor yield rate due to being a wet process. It also has the fine width limit for the pattern lines: the limit is 0.1 - 0.2 μ m, due to using a mask-pattern. However, recently, more highly integrated ultra LSI's are being required for development of more sophisticated memories and robots. For this purpose, the ion beam irradiation system is being watched. The system has features of being a perfectly dry process and has a super fine line width of 0.01 μ m. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 66] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

MICROCOMPUTER CONTROLLED WELDING MACHINE--Matsushita Electric Industry Co., a leading maker of welding machines, has developed an automatic welding machine controlled by a microcomputer. In response to a lack of skilled welding operators in the industry, the machine was designed for use by beginners but skilled welding is realized by the use of microcomputer control. In actual welding, countermeasures against noise in the electronic circuit was a serious problem caused by the arc and large current but the company has overcome the problem by applying CMOS. Conventionally, microcomputer control has been applied to special purpose welding machines already but the company has developed a general purpose machine for the first time. Behind the company, Hitachi, Osaka Henatsuki, Mitsubishi Electric Mfg. are developing new products in which microcomputers are being applied. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 66] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

MAIN SHAFT-DRIVEN GENERATOR--Ishikawajima-Harima Heavy Industries Co. has revealed plans to equip container ships equipped with 1700 TEU engines with a new type of main shaft-driven generator. This is an alternating current generator installed directly on the counter shaft between the low speed diesel main engine and propeller. With rotor coils attached directly to the counter shaft, the new generating equipment is a part of the main shaft which constitutes the rotor of the generator. The equipment incorporates an output stabilizing device that is a combination of a rectifier (direct current \rightarrow alternating current) and a motor-generator (direct current \rightarrow alternating current). [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 66] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

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OPTICAL FIBER LASER GYROCOMPASS--A research group led by Professor Niwa at the Institute of Space and Aeronautical Science, the University of Tokyo, has succeeded in basic tests of a laser gyrocompass using optical fibers. The optical fiber laser gyrocompass employs a principle in which an optical fiber 300 meters long is wound around a drum 60cm in diameter and a beam from a single laser is split into two beams for entry from both ends of the optical fiber, and the angle of rotation is detected from the interference of output light. Since the experiments are still at the basic experimental stage, the equipment is bulky and uses a helium neon laser, but the tests reportedly have succeeded in the detection of an angular velocity of 0.05 degrees per second. As a means for further raising the accuracy of the equipment and of reducing the size, the Institute is studying employment of optical heterodyne technology, by using as the light source a semiconductor laser that emits light of a 0.8 micron wavelength. By pressing ahead with trial manufacture of the equipment and by conducting further tests, the Institute is planning to lay the groundwork for the development of an optical fiber laser gyroscope. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 68] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

THERMAL PRINTER HEAD FOR THIN FILM--Kyoto Ceramics have developed a thermal printer head for thin film for facsimile equipment and have started full production. So far, this is the world's smallest using diodes for medium-speed facsimile machines. One of the main characteristics is its superior temperature stability. This thermal printer head is provided with a large number of resistances wired in layers at its top and these resistances become sources for exothermic printing. For facsimile use, a single crystal sapphire is used as the substrate material for the super high-speed model, glazed ceramic for the high-speed model, and glass for the medium-speed unit. As metal with high melting point is used for the resistances, superior temperature resistance and durability must be provided. In addition, the resulting image is of high quality because the exothermic source is of a separation type. It is easy to include the head in devices because the exothermic source is arranged at its tip. Cost-savings can be achieved because noble metals are not necessary for the leads. Production at present has started with 1,000 heads per month but in Autumn it is planned to increase this to 6,000 heads monthly. The price is estimated to be ¥40,000 to 50,000 each if production proceeds successfully. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 70] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

ASYNCHRONOUS 128K BIT MASK ROM--Oki Electronic Industries has developed MSM 38128, an asynchronous 128K bit mask ROM in NMOS. This ROM is produced by making utmost use of the same level of microprocessing technology as used for super LSI. The electronic beam exposure unit is used for production of the final ROM mask in order to shorten the delivery period of samples for evaluation. Its main characteristics are as below: (1) Easy to use because of asynchronism. (2) Power consumption is small because a standby feature is provided. That is, 120mA-Operating and 20mA-Standby. (3) Output-enable logic is selectable. The basic specifications are as follows: Word-configuration: 16k x 8 bits; Access time: 450ns max.; Power voltage: 5V±10%; Input-output: TTL compatible; Back bias: Built in; Operating temperature: 0 to 70°C;

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Package: 28-pin DIP. The company plans to start production with 50,000 ROM's per month aiming sales mainly at the office automation (OA) equipment market. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 70] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

CHARACTER PANEL DISPLAY--Oki Electric Industry Co., Ltd. has developed a Chinese character panel display unit "RD400-2F", which can give a clear display of Chinese characters. It is aimed at a Chinese character input monitor from the viewpoint that a flat-type panel display such as a keyboard which can be incorporated near the input unit will be hoped in the future to serve as the character display unit. The features are: (1) The very small dot pitch of 0.4mm for the adjacent dots enables clear display of even the complicated Chinese character which has many strokes in the natural form; (2) the display panel consists of an upper and a lower two rows, each row being of the full-dot configuration of 720 dots horizontally x 18 dots vertically, enabling display by the two rows to be up to 160 characters including, besides Chinese characters: alphabetic characters, alphanumerics, and Japanese characters, each of which is of the 7 dots x 9 dots configuration. Therefore it can also be used as a monitor of the teletyper or the printer which prints the 7 dots x 9 dots-configuration characters. The specifications are as follows: Display color: Orange. Display capacity: 40 characters x 2 rows for Chinese characters and 80 characters x 2 rows for alphabetic, alphanumeric, and Japanese characters. Dot pitch: 0.4mm. Unit dimensions: 390 (Width) x 80 (Height) x 60 (Depth) mm³. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 73] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

ON-LINE OCR, FACSIMILE SYSTEMIZATION--Communication Industrial Co. have succeeded, in cooperation, in practicalizing the on-line-OCR-FAX system which can directly input through the OCR into a computer handwritten-character information to be sent from a far-distant facsimile terminal. The features are: (1) The handwritten OCR data can be input into the computer by use of the FAX; (2) Being capable of automatically distinguishing between the input data and picture information mixed on the same manuscript, sending the input data to the OCR and receiving picture information as the hard copy; (3) Being capable of inputting even the handwritten-character information of the center through the OCR; and (4) Being capable of feeding back output data processed by the computer to the necessary position through the FAX. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 73] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

AUTOMATIC CHECK EQUIPMENT--MITI starts out on a 5-year project, starting from 1981, for decreasing and checking of radioactivity to the check personnel required for various checking work in atomic power plants and for reduction of maintenance work. In this project, they will study the technology for decreasing measurements of such as curved tube welded parts by automatic ultrasonic wave defectoscope, the automatic fuel check system, and the automatic contamination remover. The total expense for this project is estimated to amount to approximately ¥4 billion, with a subsidy ratio of 2:3. Those to which the subsidy is to be given are, with the atomic power check center at a center, each maker of the atomic power equipment of robots, aiming these developments. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 76] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

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GLASS-FIBER REINFORCED PLASTIC COMPOSITE PIPE--Kabuta, Ltd. has recently announced that it has successfully developed a glass-fiber reinforced plastic composite pipe with a diameter of 3,000mm, which is the largest in the world. The company has been given an order by a local water service bureau for a 220m long FW (Filament Winding) pipe of the same diameter to be used in a sewer. The above product is the result of Kubota's development work in FW pipes which was part of the program to strengthen the general pipe division including cast iron pipes, PVC pipes, and asbestos pipes. Originally, an FW pipe with diameter of between 600mm and 1,350mm was the main product but, recently, large size pipes with a diameter of over 1,500mm have been developed. Last year the company was given an order for a 2,600mm diameter water pipe measuring 3,650 m in length and now it has broken its own world record by developing a 3,000mm pipe. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 81] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

SEMISUBMERGED RIG--Mitsubishi Heavy Industries has recently received an order for a semisubmerged self-navigating submarine excavation rig from Petroleo Brasileiro S.A., the national petroleum corporation of Brazil. The rig recently ordered is 104.5 m long, 67m wide overall, has a possible operation depth of 450m and an excavation depth of 9000m, and is designed to withstand winds of 60m per sec. and waves 36.6m high. It is priced at around ¥17 billion. Mitsubishi Heavy Industries has received orders for 30 semisubmerged rigs including the latest one mentioned above and has, together with Mitsui Shipbuilding Co., monopolized the semisubmerged rig market in Japan. However, the development of submarine petroleum has recently been booming, inviting rapidly increasing demands for semisubmerged rigs. And now, Hitachi Zosen and Nippon Kokan are edging their way into this monopolized market, showing indications of severer competition in the market in the future. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 4, Apr 81 p 88] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

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